INSTRUCTION MANUAL

FOR THE

TYPE 242-A

FM SIGNAL GENERATOR

BOONTON RADIO CORPORATION
BOONTON, NEW JERSEY
U. S. A.

MP MASTER
MA24345

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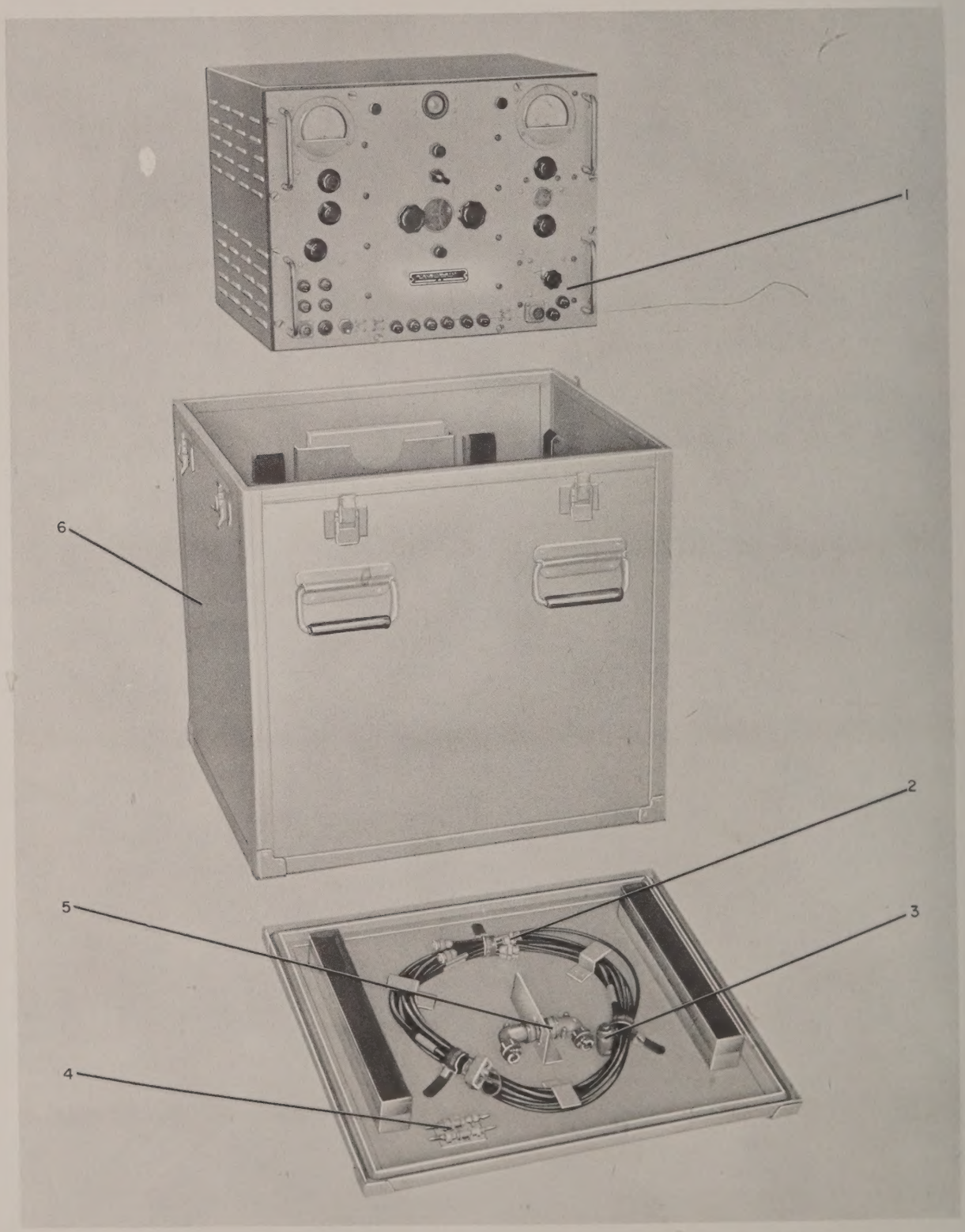


Figure 1-1. Signal Generator AN/ARM-24

SECTION I

INTRODUCTION AND DESCRIPTION

1-1. GENERAL.

1-2. This publication comprises operating instructions for Signal Generator AN/ARM-24 manufactured by the Boonton Radio Corporation of Boonton, New Jersey under contract NOas 55-724. The equipment supplied is illustrated in figure 1-1 and listed in table 1-1. The signal generator is supplied with all operating accessories required for its use.

1-3. The signal generator in the carrying case with all of the equipment listed in table 1-1 measures 21-1/4 by 23-1/4 by 19 inches and weighs 157 pounds. The signal generator alone measures 15 by 19-3/4 by 17-1/4 inches and weighs 115 pounds.

1-4. DESCRIPTION OF EQUIPMENT.

1-5. Signal Generator AN/ARM-24 is an f-m signal generator providing a crystal-controlled output at each integral megacycle point between 400 and 550 megacycles. In addition a variable-frequency oscillator, which may be calibrated against the internal crystal oscillator, provides continuous coverage between integral megacycles.

1-6. Two radio-frequency output voltage levels are provided. One is a fixed high-level output. The second is continuously adjustable and is taken through a calibrated piston attenuator. The signal generator may be frequency modulated by signals obtained from either an internal audio oscillator or an external source. An internal compressor circuit may be used with the external modulation to maintain a constant peak deviation when there are variations in the modulation signal level. A deviation metering circuit is designed to indicate the true deviation when either single- or multiple-tone modulation signals are applied.

TABLE 1-1

EQUIPMENT SUPPLIES

Quantity	Official Name	Nomenclature	Common Name
1	Generator, Signal Consisting of	AN/ARM-24	---
1	Generator, Signal	SG-199/ARM-24	Signal generator
1	Case, Signal Generator	CY-2070/ARM-24	Carrying case
3	Cable Assembly, R.F.	CG-1522/U	R-f cable
1	Cable Assembly, Power, Electrical	CX-3135/U	Power cable
2	Adapter, Connector	UG-1222/U	Adapter
2	Plug	AN3108B-14S-2P	Plug
2	Cable Clamp	AN3037-6	Clamp

LEGEND FOR FIGURE 1-1

1. Signal Generator SG-199/ARM-24
2. R.F. Cable Assemblies CG-1522/U
3. Electrical Power Cable Assembly CX-3135/U
4. Connector Adapters UG-1222/U
5. Plugs AN3108B-14S-2P
6. Signal Generator Case CY-2070/ARM-24

1-7. THEORY OF OPERATION.

1-8. The signal generator includes four functional, though not physical units. These are the audio unit, f-m unit, r-f unit, and power supplies.

1-9. AUDIO UNIT. The audio unit produces 400- or 1,000-cycle-per-second modulation for the f-m unit. In place of the locally-generated modulation signal it can accept any external signal between 300 cycles per second and 100 kilocycles and feed this signal through an amplifier to the f-m unit. The audio unit also contains a compressor that can be used instead of the amplifier if the external-signal frequency is between 7 and 80 kilocycles.

1-10. F-M UNIT. The f-m unit consists of a reactance-tube modulator, a frequency-modulated oscillator, and the necessary control circuits to stabilize the center frequency of the f-m oscillator. The output of the f-m unit is used in a mixer in the r-f unit to frequency modulate the accurately-controlled r-f signal.

1-11. R-F UNIT. The r-f unit consists of three oscillators (units and tens crystal-controlled oscillators and a variable frequency oscillator), two mixers, and the necessary frequency doublers and amplifiers to produce the required r-f output. The output of the f-m unit is mixed with the mixed outputs of these oscillators after the r-f signal has been frequency doubled twice. The frequency-modulated output of this mixer is amplified and doubled twice more to become the radio-frequency output of the signal generator.

1-12. POWER SUPPLIES. The power supplies produce all the required filament and d-c voltages for the audio, f-m, and r-f units. In addition they supply 28-volt a-c and +180-volt d-c power for external equipment which is not part of, and not necessary to the operation of, Signal Generator AN/ARM-24.

SECTION II

OPERATION

2-1. DESCRIPTION OF CONTROLS, INDICATORS, AND RECEPTACLES.

2-2. The controls, indicators, and receptacles on the front panel of the signal generator are illustrated in figure 2-1 and described in table 2-1. It is not necessary for the operator to open the case of the signal generator or to adjust any other controls.

TABLE 2-1

LOCATION AND FUNCTION OF OPERATING CONTROLS, INDICATORS, AND RECEPTACLES

Name	Index No. (Figure 2-1)	Function
Power switch	2	In ON position power is supplied to all circuits in signal generator. In HEATER position power is supplied to standby heaters only.
CORD CX-3135/U receptacle	1	Power cord connects to this receptacle.
PWR OUTPUT receptacle	3	Power cord from external equipment requiring 28 V AC and 180 V DC power connects to this receptacle.
TUNE AFC	4	Pushing in this control disables afc circuit. Turning after pushing tunes f-m oscillator.
Electric eye	5	Indicates afc tuning.
Operation selector	6	In XTAL position, selects crystal operation. In VFO position selects variable frequency operation. In XTAL + VFO position, connects both crystal and variable frequency oscillators to CARRIER MONITOR meter for calibration of vfo against crystal oscillator.
TENS frequency selector	7	Selects tens crystal and coil in tens oscillator circuit. Also tunes various r-f circuits.
UNITS frequency selector	8	Selects units crystal and tunes variable frequency oscillator.
CALIBRATE VFO	9	Fine tuning control to calibrate variable frequency oscillator against crystal oscillator.
CARRIER MONITOR meter	11	When set at red line indicates proper output to make ATTENUATOR read correctly. Also used to zero beat variable frequency oscillator against crystal oscillator.
ZERO SET	21	Adjusts needle of CARRIER MONITOR meter to zero.
RF OUTPUT receptacle	10	R-f output of signal generator appears at this receptacle.
RF LEVEL	13	Selects HI level (directly from output amplifier), or LO level (through ATTENUATOR). To operate: pull out, turn, then push back in.

TABLE 2-1

LOCATION AND FUNCTION OF OPERATING CONTROLS, INDICATORS, AND RECEPTACLES (cont)

Name	Index No. (Figure 2-1)	Function
POWER SET	14	Controls r-f output. Used to set CARRIER MONITOR meter to red line. In extreme counterclockwise position disconnects signal so that CARRIER MONITOR meter can be zero set.
ATTENUATOR	12	Adjusts low-level output between 1 and 100,000 microvolts. Also calibrated in db below 1 milliwatt from 7 to 107 db.
MODULATION SELECTOR	15	Selects source of modulation and audio circuits. Has OFF, 400∿, 1000∿, EXT MOD, and COMPRESSOR positions.
DEVIATION RANGE	16	Coarse deviation control. Has 50, 150, and 300 kc positions.
DEVIATION LEVEL	19	Fine deviation control.
MODULATION IN receptacle 560 ∿	18	External modulation signals with an impedance of approximately 560 ohms may be connected to this receptacle.
MODULATION IN receptacle 20K ∿	17	External modulation signals with an impedance of approximately 20,000 ohms may be connected to this receptacle.
MODULATION DEVIATION IN KC meter	20	Reads deviation in kilocycles.
ZERO SET	22	Adjusts needle of MODULATION DEVIATION meter to zero.

2-3. SETTING UP EQUIPMENT.

2-4. To set up the signal generator proceed as follows:

a. Open the carrying case and remove the signal generator.

b. Place the signal generator on a flat surface, such as the top of a table or workbench, which is capable of supporting the weight of the signal generator and any other equipment being used at the same time.

c. Connect the power cord from the CORD CX-3135/U receptacle (1, figure 2-1) to a source of 103.5- to 126.5-volt, 50- to 420-cps single-phase power capable of supplying 600 voltamperes.

d. Set the power switch (2) to the HEATER position and allow the signal generator to warm up for at least 1 hour.

e. Set the power switch (2) to the ON position and allow the signal generator to warm up for at least 10 minutes more.

f. If the power outputs of the signal generator are required, connect the plug from the equipment requiring the power to the PWR OUTPUT receptacle (3).

2-5. AFC TUNING. Before proceeding to use the signal generator tune the afc circuit as follows:

a. Push the TUNE AFC control (4, figure 2-1) all the way in and rotate it to the full counterclockwise position.

b. While holding the control in, turn it slowly clockwise until the electric eye (5) opens, releasing the control at the instant the eye opens.

c. When the control is released, the eye should revert to the half-open position. This indicates that the afc circuit is properly tuned. If the eye does not revert to the half-open position or if it opens fully or closes during operation of the signal generator, repeat steps a. and b.

d. During prolonged use of the signal generator, repeat steps a. and b. at least every half hour.

2-6. OPERATION.

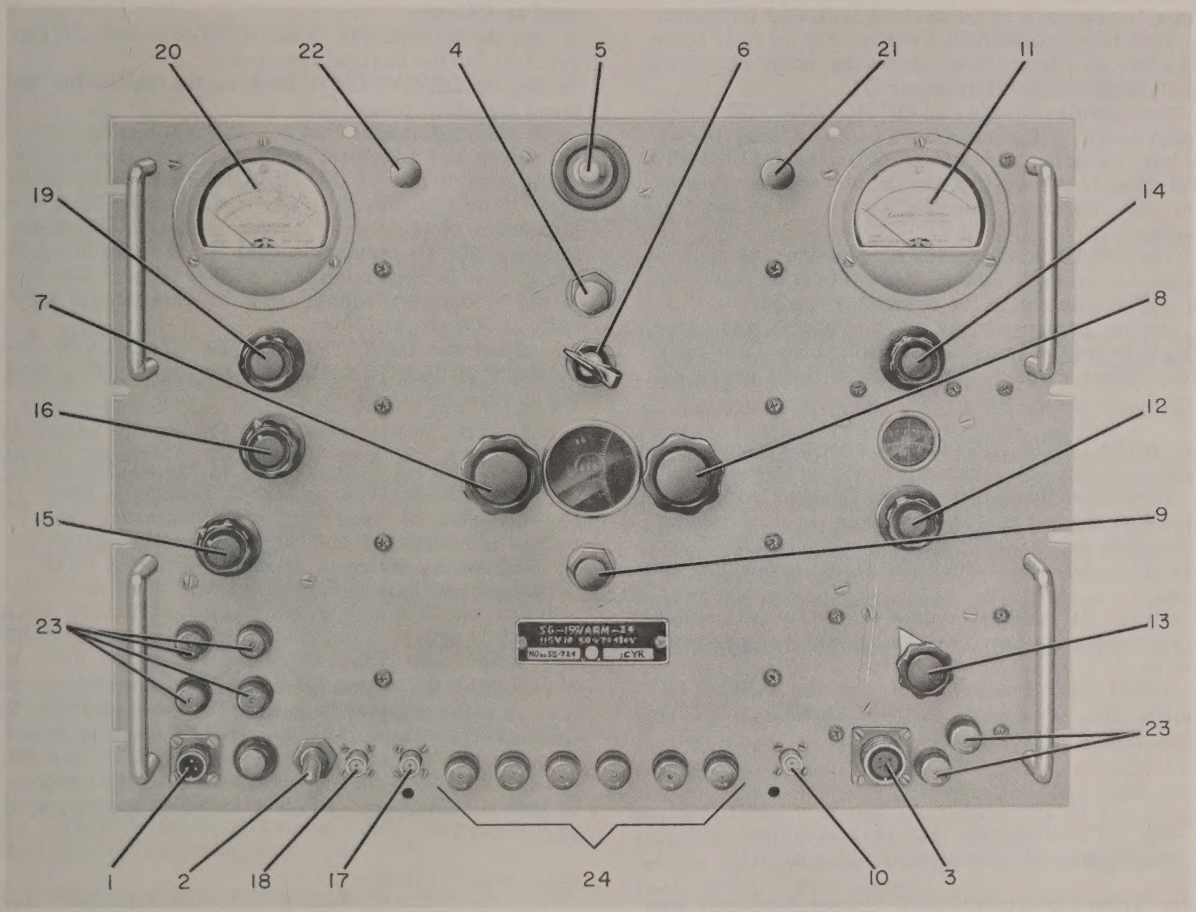
2-7. CRYSTAL OPERATION. When a center frequency of an integral megacycle is required, the signal generator may be set for crystal operation as follows:

a. Set the operation selector switch (6, figure 2-1) to the XTAL position.

b. Set the TENS and UNITS selectors (7 and 8) to the desired center frequency.

2-8. VARIABLE FREQUENCY OSCILLATOR OPERATION. When a center frequency which is not an integral megacycle is required, the signal generator must be set for variable frequency oscillator operation as follows:

a. Set the operation selector switch (6, figure 2-1) to the XTAL + VFO position.



1. CORD CX-3135/U receptacle
2. Power switch
3. PWR OUTPUT receptacle
4. TUNE AFC control
5. Electric eye tube
6. Operation selector switch
7. TENS frequency selector
8. UNITS frequency selector
9. CALIBRATE VFO control
10. RF OUTPUT receptacle
11. CARRIER MONITOR meter
12. ATTENUATOR
13. RF LEVEL switch
14. POWER SET control
15. MODULATION SELECTOR switch
16. DEVIATION RANGE switch
17. 20K MODULATION IN receptacle
18. 560 MODULATION IN receptacle
19. DEVIATION LEVEL control
20. MODULATION DEVIATION meter
21. ZERO SET control (for CARRIER MONITOR meter)
22. ZERO SET control (for MODULATION DEVIATION meter)
23. LINE fuses
24. SPARE fuses

Figure 2-1. Signal Generator SG-199/ARM-24, Front Panel

b. Set the TENS and UNITS selectors (7 and 8) to within 1 megacycle of the desired operating frequency.
c. Turn the CALIBRATE VFO control (9) fully counterclockwise, then rotate clockwise while observing the CARRIER MONITOR meter (7).
d. The needle on the CARRIER MONITOR meter should move to the right then begin to drop back to the left, vibrating as it drops. With the CALIBRATE VFO control set so that the meter needle vibrates, turn the operation selector switch (6) to the VFO position.
e. The UNITS selector (8) is now free to move 1 megacycle on each side of the calibration point. Set the UNITS selector to the desired frequency.
f. During prolonged use of the signal generator, when it is set for variable frequency oscillator operation, repeat steps a. through e. at least every half hour.

2-9. HIGH-LEVEL OUTPUT. To set the signal generator for high-level output proceed as follows:
a. Terminate the r-f output in a 50-ohm load by using one of the r-f cables and adapters, if necessary, to connect the RF OUTPUT receptacle (10, figure 2-1) to the load into which the signal generator will work.
b. Set the RF LEVEL control (13) to the HI position by pulling out the control, turning, and then pushing it back in.
c. Adjust the r-f output by turning the POWER SET control (14). Full scale on the CARRIER MONITOR meter (11) is approximately 2 volts.

NOTE

The ATTENUATOR (12) is inoperative with the RF LEVEL control in the HI position.

2-10. LOW-LEVEL OUTPUT. To set the signal generator for low-level output proceed as follows:
a. Set the RF LEVEL control (13, figure 2-1) to the LO position by pulling out the control, turning, then pushing it back in.
b. Adjust the POWER SET control (14) until the CARRIER MONITOR meter needle (11) is aligned with the red line.
c. Rotate the ATTENUATOR control (12) until the dial indicates the desired output. The calibration is accurate only when the RF OUTPUT receptacle (10) is terminated in a 50-ohm load.

2-11. MODULATION. To modulate the r-f output proceed as follows:
a. Set the MODULATION SELECTOR switch (15, figure 2-1) for the desired function.
b. Set the DEVIATION RANGE switch (16) for the desired deviation range.
c. If external modulation is required, use one of the r-f cables and adapters, if necessary, to connect the modulation to one of the MODULATION IN receptacles (17 or 18). Use the 560-Ω receptacle (18) if the impedance of the source is approximately 560 ohms. Use the 20K-Ω receptacle (17) if the impedance of the source is approximately 20,000 ohms. The external modulation voltage must be between 0.8 and 6 volts at 300 cps to 100 kc.
d. Adjust the DEVIATION LEVEL control (19) until the MODULATION DEVIATION meter (20) reads the desired deviation.

NOTE

The COMPRESSOR position of the MODULATION SELECTOR switch (19) may be used only when the frequency of the external signal is between 7 and 80 kc. When the COMPRESSOR position is used, the deviation level is automatically maintained.

2-12. STANDBY.

2-13. After the signal generator is in operation it may be set to standby by setting the power switch (2, figure 2-1) to the HEATER position. When it is desired to use the signal generator again, return the switch to the ON position and allow a 10-minute warm-up period before use. After 10 minutes proceed with paragraph 2-5.

2-14. SHUTDOWN.

2-15. If the signal generator is to be used in the same location it may be shut down by setting the power switch (2, figure 2-1) to the HEATER position and removing the plug from the power source. If the signal generator is to be moved proceed as follows:
a. Set the power switch (2) to the HEATER position.
b. Remove all cables and adapters and store them in the cover of the carrying case.
c. Return the signal generator to the carrying case and put the cover on the case. Secure the cover onto the case with the catches on the sides of the case.

SECTION III

OPERATING CHECKS AND ADJUSTMENTS

3-1. GENERAL.

3-2. Except for observing that the electric eye (5, figure 2-1) remains half open during operation, no operating checks are necessary when operating the signal generator. Only four operating adjustments are required and these are described in the following paragraphs.

3-3. ZEROING METERS.

3-4. CARRIER MONITOR METER. Zero the CARRIER MONITOR meter (11, figure 2-1) as follows before using the signal generator:

a. With the signal generator fully warmed up and the power switch (2) in the ON position set the POWER SET control (14) fully counterclockwise.

b. Adjust the ZERO SET control (21) until the CARRIER MONITOR meter reads zero.

c. Reset the POWER SET control as desired if the high-level output is used, or to align the needle of the CARRIER MONITOR meter with the red line if the low-level output is used.

3-5. MODULATION DEVIATION METER. Zero the MODULATION DEVIATION meter (20, figure 2-1) as follows before using the signal generator:

a. With the signal generator fully warmed up and the power switch (2) in the ON position set the MODULATION SELECTOR switch (15) to the OFF position.

b. Adjust the ZERO SET control (22) until the MODULATION DEVIATION meter reads zero.

c. Return the MODULATION SELECTOR switch to the desired position.

3-6. AFC TUNING.

3-7. Tune the afc circuit as follows, every time the signal generator is turned on, every half hour during prolonged use, and any time the electric eye (5, figure 2-1) opens fully, or closes, while the signal generator is in use:

a. Push the TUNE AFC control (4) all the way in and rotate it to the full counterclockwise position.

b. While holding the control in, turn it slowly clockwise until the electric eye (5) opens, releasing the control at the instant the eye opens.

c. When the control is released the eye should revert to the half-open position. This indicates that the afc circuit is properly tuned. If the eye does not revert to the half-open position, repeat steps a. and b.

3-8. VARIABLE FREQUENCY OSCILLATOR CALIBRATION.

3-9. Calibrate the variable frequency oscillator as follows, every time it is used, every time the output frequency is changed more than ±1 mc from the frequency at which the last calibration was made, and every half hour during prolonged use of the signal generator at one frequency of the vfo:

a. Set the operation selector switch (6, figure 2-1) to the XTAL + VFO position.

b. Set the TENS AND UNITS selectors (7 and 8) to within 1 megacycle of the desired operating frequency.

c. Turn the CALIBRATE VFO control (9) fully counterclockwise, then rotate clockwise while observing the CARRIER MONITOR meter (11).

d. The needle on the CARRIER MONITOR meter should move to the right then begin to drop back to the left, vibrating as it drops. With the CALIBRATE VFO control set so that the meter needle vibrates, turn the operation selector switch (6) to the VFO position.

e. Set the UNITS selector (8) to the desired frequency. This frequency must be within ±1 mc of the calibration frequency.

SECTION IV

EMERGENCY OPERATION AND REPAIR

4-1. GENERAL.

4-2. Other than normal operation of the signal generator is not possible. However, the signal generator can be operated when certain of its circuits are not functioning provided these circuits are not necessary for the desired functions. Table 4-1 lists the circuits that are not necessary for all functions of the signal generator, the functions that the signal generator cannot perform when these circuits are inoperative, and substitutes for these functions.

4-3. REPLACEMENT OF FUSES.

4-4. If the signal generator as a whole or any of the specific circuits fails to operate, check the LINE fuses (23, figure 2-1). If a LINE fuse is blown replace it with a SPARE fuse (24) of the same current rating. If the replacement fuse also blows, the signal generator is defective and must be repaired. Do not replace the fuse a second time.

TABLE 4-1

EMERGENCY OPERATION

Non-Functioning Circuit	Function that Cannot Be Performed	Substitute
28-volt a-c and 180-volt	Supply of power to external equipment.	Obtain power from another source.
Audio oscillator	400- and 1000-cps modulation.	Use external modulation of these frequencies.
Compressor circuit.	Compressed audio modulation.	Use external compressor or modulation not requiring compression.
Entire audio unit	All modulation.	If possible, use signal generator without modulation.
Interpolation oscillator	VFO operation.	Use crystal operation. However, operation will be possible at integral megacycles only.
Units crystal oscillator	XTAL operation.	Use vfo operation. However, it will not be possible to calibrate the vfo.

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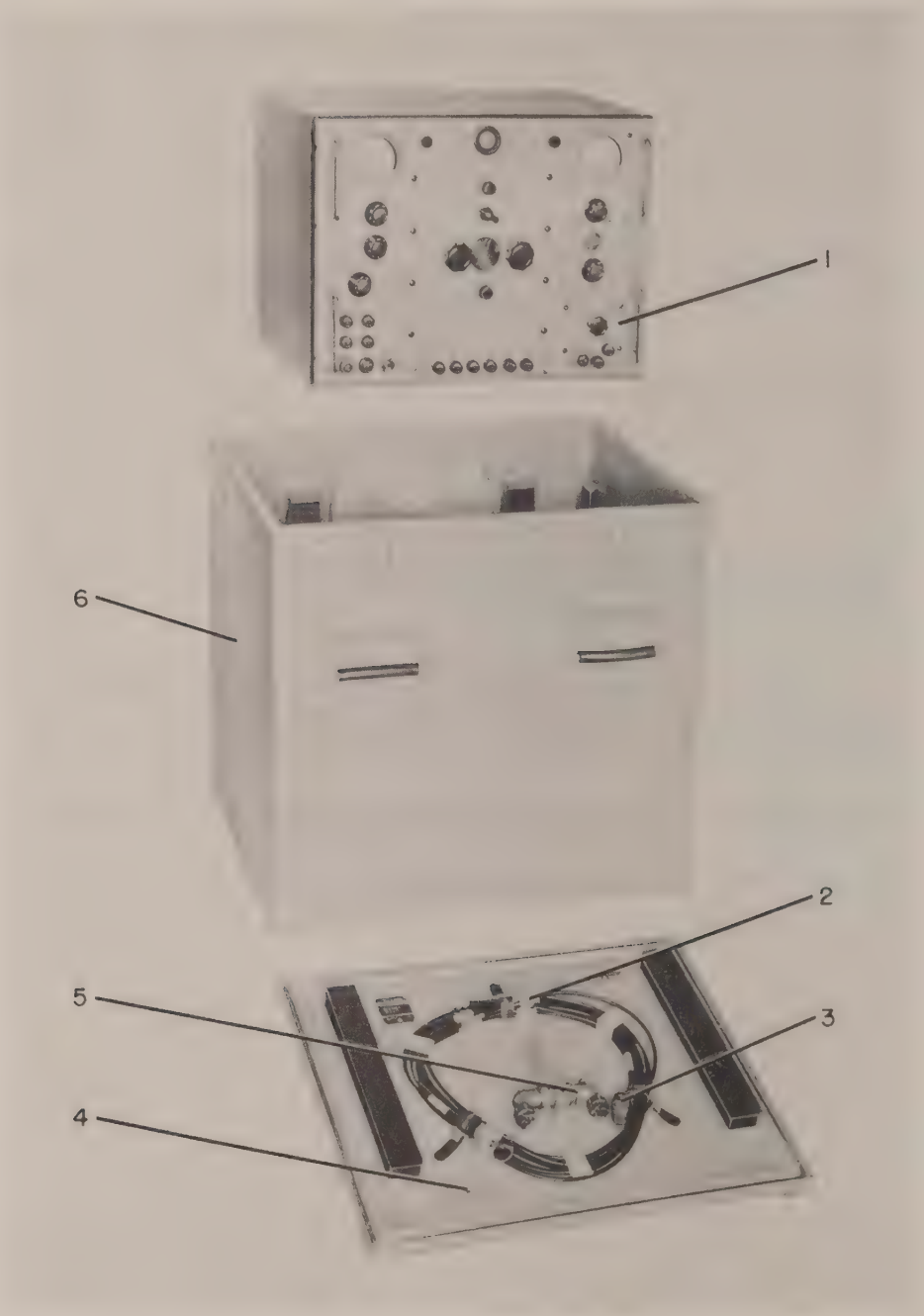
INTRODUCTION

This publication is one of a series of handbooks describing Signal Generator AN/ARM-24. For additional information concerning these equipments, refer to the associated publications listed below.

Title	USN Code Number	USAF T. O. Number
Handbook Operating Instructions	NAVAER 16-30ARM24-501	T. O. 33A1-8-127-1
Handbook Overhaul Instructions	NAVAER 16-30ARM24-503	T. O. 33A1-8-127-3
Illustrated Parts	NAVAER 16-30ARM24-504	T. O. 33A1-8-127-4



1. Signal Generator SG-199/ARM-24
2. RF Cable Assemblies CG-1522/U
3. Electrical Power Cable Assembly CX-3135/U
4. Connector Adapters UG-1222/U
5. Plugs AN3108B-14S-2P
6. Signal Generator Case CY-2070/ARM-24

Figure 1-1. Signal Generator AN/ARM-24

SECTION I

DESCRIPTION AND LEADING PARTICULARS

1-1. GENERAL.

1-2. This publication comprises service instructions for Signal Generator AN/ARM-24, manufactured by the Boonton Radio Corporation, Boonton, New Jersey, under contract NOas 55-724. The equipment supplied is illustrated in figure 1-1 and listed, with weights and dimensions, in table 1-1.

1-3. Sections I through VII of this handbook apply to Signal Generator AN/ARM-24 manufactured under contract NOas 55-724. Additional models will be covered in Section VIII by the use of difference data sheets.

1-4. Service instructions for models included in Section VIII are the same as the procedures given in Sections I through VII except for the specific differences noted by the applicable difference data sheets.

1-5. PURPOSE OF EQUIPMENT.

1-6. Signal Generator AN/ARM-24 is an F-M signal generator providing a crystal-controlled output at each integral 1-mc point in the frequency range from 400 to 550 mc. In addition, a variable-frequency oscillator, which may be calibrated against the internal crystal oscillator, provides continuous coverage between integral megacycles.

1-7. Two r-f output voltage levels are provided. One is a fixed high-level output. The second is continuously adjustable and is taken through a calibrated piston attenuator. The signal generator may be frequency modulated by signals obtained from either an internal audio oscillator or an external source. An internal compressor circuit may be used with the external modulation to maintain a constant peak deviation when there are variations in the modulation signal level. A deviation metering circuit is designed to indicate the true deviation when either single- or multiple-tone modulation signals are applied.

TABLE 1-1

EQUIPMENT SUPPLIED

Quantity	Name	Nomenclature	Dimensions (inches) Height	Width	Length	Weight (pounds)
1	Generator, Signal Consisting of:	AN/ARM-24	21-1/4	23-1/4	19	157
1	Generator, Signal	SG-199/ARM-24	15	19-3/4	17-1/4	115
1	Case, Signal Generator	CY-2070/ARM-24	21-1/4	23-1/4	19	40
3	Cable Assembly, RF	CG-1522/U	---	---	74	---
1	Cable Assembly, Power, Electrical	CX-3135/U	---	---	96	1
2	Adapter, Connector	UG-1222/U	---	---	---	---
2	Plug	AN3108B-14S-2P	---	---	---	---
2	Cable Clamp	AN3037-6	---	---	---	---

1-8. TUBE COMPLEMENT.

1-9. The electron tubes used in the signal generator are listed in table 1-2 with their MIL types and functions.

1-10. FUSE COMPLEMENT.

1-11. The fuses used in the signal generator are listed in table 1-3 with their types and ratings.

1-12. OUTPUT CHARACTERISTICS.

1-13. FREQUENCY RANGE. The signal generator covers a range of 400 to 550 mc. Internal crystal control is provided at integral megacycle points to an accuracy of ±0.002 percent. Continuous coverage between the integral megacycles is provided by a variable-frequency oscillator accurate to ±0.01 percent.

TABLE 1-2

TUBE COMPLEMENT

Unit	Quantity	Reference Symbol	MIL Type No.	Function
Audio	1	V101	12AT7WA	Audio Oscillator
	1	V102	6AU6WA	Compressor
	1	V103	6AU6WA	Transient Balance
	1	V104	6AU6WA	Compressor
	1	V105	6AU6WA	Transient Balance
	1/2	V106A	1/2 12AT7WA	Amplifier
	1/2	V106B	1/2 12AT7WA	Cathode Follower
	1/2	V107A	1/2 5726/6AL5	Detector
	1/2	V107B	1/2 5726/6AL5	Peak Detector
	1	V108	12AT7WA	D-C Amplifier
	1	V109	12AT7WA	Amplifier
	1	V110	5814A	Cathode Follower
	1/2	V111A	1/2 12AT7WA	Amplifier
	1/2	V111B	1/2 12AT7WA	Cathode Follower
	1	V112	12AT7WA	VTVM Tube
F-M	1	V201	6AH6	Reactance Tube
	1/2	V202A	1/2 5814A	F-M Oscillator
	1/2	V202B	1/2 5814A	Buffer Amplifier
	1/2	V203A	1/2 12AT7WA	Buffer Amplifier
	1/2	V203B	1/2 12AT7WA	Amplifier
	1/2	V204A	5751	Mixer
	1/2	V204B	5751	Amplifier
	1	V205	12AT7WA	Reference Oscillator

TABLE 1-2 (cont)

TUBE COMPLEMENT

Unit	Quantity	Reference Symbol	MIL Type No.	Function
F-M (cont)	1	V206	6AH6	Limiter
	1	V207	6005/6AQ5	Limiter
	1	V208	5726	Peak-to-Peak Detector
	2	V209 V210	2 5726	Frequency Counter
	1	V211	5751	Differential D-C Amplifier
	1	V212	5751	D-C Amplifier
Power Supply	1	V401	5R4WGB	Rectifier
	1	V402	5N045T	Time Delay Relay
	1	V403	5R4WGB	Rectifier
	1	V404	5N045T	Time Delay Relay
	1	V405	5Y3WGTA	Rectifier
	1	V406	5896	Voltage Doubler
	1	V407	6080WA	Series Regulator
	1	V408	6AU6WA	Control Tube
	1	V409	5651WA	Voltage Regulator
	1	V410	6080WA	Series Regulator
	1	V411	6AU6WA	Control Tube
	1	V412	5651WA	Voltage Regulator
	1	V413	OA2WA	Voltage Regulator
R-F	1	V501	5718	Amplifier Detector
	1	V502	5725	Mixer
	1	V503	5654/6AK5W	Amplifier
	2	V504 V505	2 5654/6AK5W	Doublers
	1	V506	5725	Mixer
	1	V507	5654/6AK5W	Amplifier
	2	V508 V509	6AN4	Amplifiers
	1	V510	6AU6WA	Tens Oscillator
	1	V511	6AU6WA	Units Oscillator

TABLE 1-2 (cont)

TUBE COMPLEMENT

Unit	Quantity	Reference Symbol	MIL Type No.	Function
R-F (cont)	1	V512	6AH6	Interpolation Oscillator
	2	V513 V514	2 5654/6AK5W	Doublers
	1	V515	12AT7WA	VTVM Tube
	1	V516	6E5	Electron-Ray Tube

TABLE 1-3

FUSE COMPLEMENT

Quantity	Reference Symbols	MIL Type No.	Rating (Amp)
2	F401 and F402	F02G2R00A	2
2	F403 and F404	MDX-4	4
2	F405 and F406	F02G1R00B	1
2	Spares	F02GR00A	2
2	Spares	MDX-4	4
2	Spares	F02G1R00B	1

1-14. VOLTAGE. Two output voltages are available from the signal generator. One is a fixed high-level output at a minimum of 1.5 volts. The second is a calibrated, variable, low-level output that can be adjusted to any voltage between 1 and 100,000 microvolts.

1-15. IMPEDANCE. The impedance of the r-f output is 50 ohms resistive with a voltage standing wave ratio not exceeding 2 db.

1-16. CHARACTERISTICS OF FREQUENCY MODULATION.

a. Deviation - 0 to 300 kc continuously variable.
b. Amplitude distortion - Less than 3 percent at 300-kc deviation.
c. Phase distortion - Linear with modulation frequency within ±1 degree from 1 to 100 kc.
d. Internal modulation - 400 and 1,000 cps ±2 percent.
e. External modulation requirements - 0.8 to 6.0 volts rms, at 300 cps to 100 kc, into either 560 or 20,000 ohms.
f. Spurious r-f output - At least 40 db below signal.
g. Incidental FM - Spurious modulating frequencies up to 100 kc, at least 25 db below 300 kc.
h. Incidental AM - Less than 10 percent of 300-kc deviation.

1-17. POWER OUTPUTS. In addition to the r-f output the signal generator has two power outputs to auxiliary equipment. These are: +180 volts dc, 45 ma, and 28 volts ac, 1.1 amp.

1-18. POWER REQUIREMENTS.

1-19. The signal generator, when in full operation, requires 600 VA from a 105- to 125-volt, 50- to 420-cps, single-phase source. The power requirements include power required to produce the power outputs described in paragraph 1-17.

1-20. LOCATION AND FUNCTION OF OPERATING AND ADJUSTMENT CONTROLS USED IN NORMAL OPERATION.

1-21. The operating and adjustment controls on the signal generator that are used in normal operation are all front-panel controls. Figure 1-2 illustrates these controls and they are listed with their functions in table 1-4.

1. Cord CX-3135/U
2. Power Switch
3. PWR OUTPUT Receptacle
4. TUNE AFC Control
5. Electric-Ray Tube
6. Operation Selector Switch
7. TENS Frequency Selector
8. UNITS Frequency Selector
9. CALIBRATE VFO Control
10. RF OUTPUT Receptacle
11. CARRIER MONITOR Meter
12. ATTENUATOR
13. RF LEVEL Switch
14. POWER SET Control
15. MODULATION SELECTOR Switch
16. DEVIATION RANGE Switch
17. 20K MODULATION IN Receptacle
18. 560 MODULATION IN Receptacle
19. DEVIATION LEVEL Control
20. MODULATION DEVIATION Meter
21. ZERO SET Control (For CARRIER MONITOR Meter)
22. ZERO SET Control (For MODULATION DEVIATION Meter)
23. LINE Fuses
24. SPARE Fuses
25. Power-on Lamp

Figure 1-2. Front Panel Controls and Indicators

TABLE 1-4

LOCATION AND FUNCTION OF OPERATING AND ADJUSTMENT CONTROLS
USED IN NORMAL OPERATION

Control Name	Reference Symbols	Index No. (Figure 1A-2)	Function
ZERO SET	R182	22	Adjusts needle of MODULATION DEVIATION meter M101 to zero.
MODULATION DEVIATION meter	M101	20	Indicates frequency deviation in kilocycles.
ZERO SET	R507	21	Adjusts needle of CARRIER MONITOR meter M501 to zero.
CARRIER MONITOR meter	M501	11	When set at red line calibrates ATTENUATOR dial. Also calibrates variable frequency oscillator against crystal.
TUNE AFC	C215, S201	4	Pushing in this control disables afc circuit in f-m unit. Turning control after pushing in tunes f-m oscillator as indicated by electron-ray tube V516.
Operation selector	S501	6	In XTAL position, selects crystal operation. In VFO position, selects variable frequency operation. In XTAL + VFO position, connects both crystal and variable frequency oscillators to CARRIER MONITOR meter M501 for calibration of vfo against crystal oscillator.
TENS frequency selector	S506, C558, C562, C566, C568, C570, C573, C575, C578	7	Switch selects tens crystal and coil in tens oscillator circuit. Capacitors tune various circuits in r-f unit.
UNITS frequency selector	S505, C615	8	Switch selects units crystal. Capacitor tunes variable frequency oscillator.
CALIBRATE VFO	C613	9	Fine tuning control to calibrate variable frequency oscillator against crystal oscillator.
DEVIATION LEVEL	R119	19	Fine deviation control.
DEVIATION RANGE	S102	16	Coarse deviation control. Has 50, 150, and 300 kc positions.
MODULATION SELECTOR	S101	15	Selects source of modulation and circuits in audio unit. Has OFF, 400 , 1000 , EXT MOD, and COMPRESSOR positions.
POWER SET	R428, S507	14	Potentiometer controls r-f output by controlling plate voltage on r-f output amplifier. Switch disconnects signal from vtvm tube so that CARRIER MONITOR meter can be zero set.

TABLE 1-4

LOCATION AND FUNCTION OF OPERATING AND ADJUSTMENT CONTROLS USED IN NORMAL OPERATION

Control Name	Reference Symbols	Index No. (Figure 1A-2)	Function
ATTENUATOR	Z501	12	Adjusts low-level output between 1 and 100,000 microvolts. Also calibrated in db below 1 mw from 7 to 107 db.
RF LEVEL	S504	13	Selects HI level (directly from output amplifier), or LO level (through ATTENUATOR).
Power switch	S401	2	In ON position power is supplied to all circuits in signal generator. In HEATER position power is supplied to heaters in signal generator and to crystal ovens for tens and units crystals.
Power-on lamp	I401	25	Illuminates when the power switch is in the OD position.
Electron-ray tube (indicator)	V516	5	Indicates proper tuning of the afc circuit.

SECTION II

TEST EQUIPMENT AND SPECIAL TOOLS

2-1. TEST EQUIPMENT.

2-2. The test equipment required for maintenance of Signal Generator AN/ARM-24 is listed in table 2-1.

2-3. SPECIAL TOOLS.

2-4. No special tools are required for this equipment.

2-5. All cables required for operation and maintenance of Signal Generator AN/ARM-24 are supplied. There is no need to fabricate interconnecting cables from spares and bulk supplies.

TABLE 2-1

TEST EQUIPMENT REQUIRED FOR MAINTENANCE

Name	AN or Manufacturer's Type	Alternate	Use
Transfer oscillator	Hewlett-Packard Model 540A		Measures r-f frequencies.
Electronic counter	Hewlett-Packard Model 524B	Northeast Engineering Model NE-14-20FM	Indicates output of transfer oscillator.
Frequency converter	Hewlett-Packard Model 525A		Extends the electronic counter's range in decade steps through 100 mc.
Audio code	KY-51/ARW		Generates audio frequencies for tests.
A-c wattmeter	Weston Model 432	Simpson Model 390	Measures a-c power.
50-ohm, 1/2-watt, non-inductive resistance	Commercial		Used in spurious a-m test.
1,000-ohm, 1/2-watt non-inductive resistance	Commercial		Used in spurious a-m test.
1N25 crystal diode	Commercial		Used in spurious a-m test.
20 db attenuator (500-ohm resistive impedance)	Commercial		Used in output amplitude test.
35-ohm, 50-watt rheostat	Commercial		Used in coder supply voltage test.
5,000-ohm, 25-watt rheostat	Commercial		Used in coder supply voltage test.
R-f patch cords (3)	General Radio Type 874-R22		Used in output impedance test.
F-m receiver	AN/ARW-56		Demodulates f-m signals.
Vacuum Tube Voltmeter	Measurements Model 62	Hewlett-Packard Model 410B	Measures resistance and a-c and d-c voltages.

TABLE 2-1

TEST EQUIPMENT REQUIRED FOR MAINTENANCE (cont)

Name	AN or Manufacturer's Type	Alternate	Use
Audio signal generator	Dumont Model 348	Hewlett-Packard Model 202C	Generates frequencies from 1 to 500,000 cps.
Oscilloscope	Dumont Model 304A	Hewlett-Packard Model 130A	Displays various wave-shapes in equipment.
Distortion analyzer	Hewlett-Packard Model 330B	Donner Model 21 Wave Analyzer	Measures audio distortion.
Wave analyzer	Sierra Model 121		Measures the individual components of complex waves.
A-c ammeter	Weston Model 528	Simpson Model 59-3A-AC	Measures a-c current.
Multimeter	Simpson Model 260	Triplett Model 630	Measures resistance, a-c and d-c voltage, and d-c current.
Frequency converter	Hewlett-Packard Model 525B		Extends the electronic counter's range from 100 mc to 220 mc in 10 mc steps.
Bolometer bridge	Polytechnic Research and Development 650B Universal Power Bridge with 627A Bolometer		Measures r-f power.
Audio voltmeter	Ballantine Model 300	Hewlett-Packard Model 400AB	Measures audio voltages from 10 to 150,000 cps.
Unit oscillator	General Radio Model 1209B	General Radio Model 1021AU	Generates frequencies from 250 to 920 mc.
I-f amplifier	General Radio Model 1216A		Detects and measures i-f signals.
Slotted line	Hewlett-Packard Model 805A	General Radio Model 874-LBA	Measures load impedance and wavelength of the r-f signal.
Mixer	General Radio Model 874MR		Used as a first detector in the heterodyne frequency converter.

SECTION III

PREPARATION FOR USE AND RESHIPMENT

3-1. CONSIDERATIONS IN SELECTING AN OPERATING SITE.

3-2. Maintenance personnel will not choose the building or room in which Signal Generator AN/ARM-24 is operated. They may, however, have some choice in the location of the signal generator within the room. The room should be well lighted and ventilated. A suitable source of primary power should be available, as well as adequate bench and floor space.

3-3. SYSTEM CABLING.

3-4. Figure 3-1 is a system cabling diagram. The connections to be established are listed in table 3-1. This table also indicates cables used for connections to an external source of modulation and from the power output receptacle of the signal generator when either of these applications is employed.

3-5. PREPARATION FOR USE.

3-6. GENERAL. The following procedure prepares the signal generator for use. In order to insure that the equipment is properly installed and in proper working order, these instructions should be followed completely and in the order listed.

3-7. UNPACKING. Unpack the equipment as follows:

a. Inspect the crates for obvious damage and report any irregularities to the proper authority.

b. Clip the metal bands used for fastening the crates. Remove the nails securing the top and all sides of the crate. Use a nail puller to avoid damaging the contents.

c. Remove the equipment from the inner and outer corrugated cardboard cartons, and from the filler and desiccant material.

d. Open the carrying case, remove the signal generator, and place it on the work bench or other flat surface.

e. Check the contents of the crate against the packing list. Report any irregularities to the proper authority.

f. Be sure to store the signal generator case and, if possible, store the shipping crate and packing materials for future use.

3-8. INSPECTION. Inspect the equipment as follows:

a. Examine the equipment for damage, such as broken connectors, bent panels, and cracked glass.

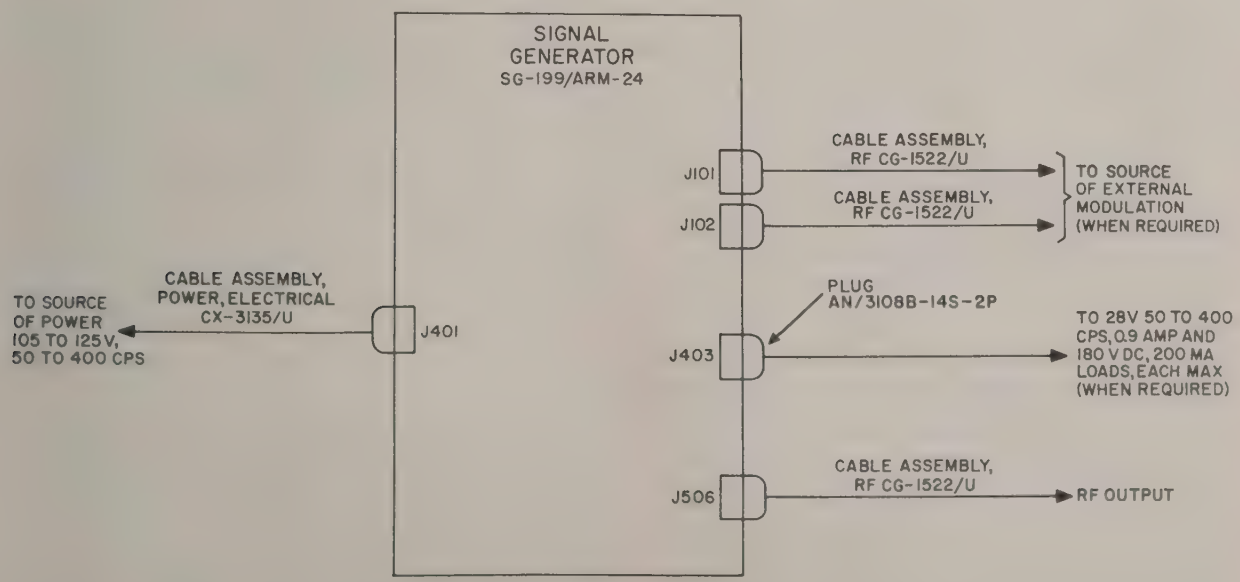

SIGNAL GENERATOR SG-199/ARM-24
J101
CABLE ASSEMBLY, RF CG-1522/U
J102
CABLE ASSEMBLY, RF CG-1522/U
TO SOURCE OF EXTERNAL MODULATION (WHEN REQUIRED)
J401
CABLE ASSEMBLY, POWER, ELECTRICAL CX-3135/U
TO SOURCE OF POWER 105 TO 125 V, 50 TO 400 CPS
J403
PLUG AN/3108B-14S-2P
TO 28V 50 TO 400 CPS, 0.9 AMP AND 180 V DC, 200 MA LOADS, EACH MAX (WHEN REQUIRED)
J506
CABLE ASSEMBLY, RF CG-1522/U
RF OUTPUT

Figure 3-1. System Cabling Diagram

b. Check that all tubes are securely mounted and not cracked. Make certain that tube shields are in place and firmly seated. Check that plug and cable assemblies are properly connected with plugs correctly seated.

c. Make a complete report of any damage or irregularities to the proper authority.

3-9. INSTALLATION OF CABLES. Install the power cable and r-f output cable according to figure 3-1 and table 3-1. Do not connect the power cable to a source of power at this time.

3-10. MINIMUM PERFORMANCE STANDARDS. Check that the equipment meets the minimum performance standards outlined in Section V of this manual. The equipment is now ready for operation.

3-11. PREPARATION FOR RESHIPMENT.

3-12. To prepare the Signal Generator AN/ARM-24 for reshipment, proceed as follows:

a. Disconnect the power, modulation, and r-f cables, coil them, and place them in the lid of the Signal Generator Case CY-2070/ARM-24.

b. Place the signal generator in the case so that it will be securely held by the rubber supports lining the case. Fasten the lid securely.

c. Crate the Signal Generator, if possible, using the original crate in which the equipment was shipped and prepare corrugated cartons and desiccant material. All packing and packaging is to be done in accordance with Specification JAN-P-658.

TABLE 3-1

SYSTEM CABLING

Cable	Connection Points	
	From	To
Cable Assembly, Power CX-3135/U	J401	Source of 105- to 125-V, 50- to 400-cps, single-phase power capable of supplying 600 volt-amperes.
Cable Assembly, RF CG-1522/U	J506	R-f output load of signal generator.
Cable Assembly, RF CG-1522/U	J101	Source of external modulation having 560-ohm output impedance (when required). Use UG-1222/U adapter at source when necessary.
Cable Assembly, RF CG-1522/U	J102	Source of external modulation having 20,000-ohm output impedance (when required). Use UG-1222/U adapter at source when necessary.
Suitable four-conductor shielded cable with AN/3108B-14S-2P plug AN3037-6 cable clamp.	J403	28-V, 0.9 amp, 50- to 400-cps, single-phase and 180-V, 200 ma, loads, each max (when required).

SECTION IV

THEORY OF OPERATION

4-1. GENERAL SYSTEM OPERATION.

4-2. GENERAL. Signal Generator AN/ARM-24 produces an accurately controlled r-f output between 400 and 550 mc. This output can be frequency-modulated by signals produced either in the signal generator or externally. The signal generator includes four functional, though not physical, units. These are the audio unit, f-m unit, r-f unit, and power supplies.

4-3. AUDIO UNIT. The audio unit produces 400- or 1,000-cps modulation for the f-m unit. In place of the locally generated modulation signal it can accept any external signal between 300 cps and 100 kc and feed this signal through either an amplifier or a compressor to the f-m unit.

4-4. F-M UNIT. The f-m unit consists of a reactance-tube modulator, a frequency-modulated oscillator, and the necessary control circuits to stabilize the center frequency of the f-m oscillator. The output of the f-m unit is used in a mixer in the r-f unit to frequency-modulate the accurately controlled r-f signal.

4-5. R-F UNIT. The r-f unit consists of three oscillators (units and tens crystal-controlled oscillators and a variable frequency oscillator), two mixers, and the necessary frequency doublers and amplifiers to produce the required r-f output. The output of the f-m unit is mixed with the mixed outputs of these oscillators after the r-f signal has been doubled twice. The output of the r-f unit is thus frequency modulated.

4-6. POWER SUPPLIES. The power supplies produce all the required filament and d-c voltages for the audio, f-m, and r-f units and also supply a-c and d-c voltages for external equipment which is not part of the signal generator.

4-7. AUDIO UNIT. (See figure 7-1.)

4-8. GENERAL. Figure 4-1 is a block diagram of the audio unit. The modulation signal either produced in the audio unit or taken from an external source is fed, after processing, through switch S101E. Paragraphs 4-9 through 4-11 trace the various possible signals to switch S101E.

4-9. With MODULATION SELECTOR switch S101 in the 400∿ or the 1000∿ position, signals of these frequencies are produced by audio oscillator V101, a Wien bridge oscillator. These signals are fed directly into switch S101E.

4-10. With S101 in the EXT MOD position, external signals are used for modulation. The external signals may be fed into the signal generator via MODULATION IN jack J1 (560Ω) or J2 (20KΩ). The output characteristics of the audio-producing equipment determine which jack is to be used. In either case, the signals pass through a matching network to switch S101C. With S101 in the EXT MOD position, the signals are amplified by V109B and fed to S101E.

4-11. With S101 in the COMPRESSOR position, the same signals as described in paragraph 4-10 may be fed into the signal generator. These signals then pass through the compressor circuit and amplifier V109A to switch S101E. The compressor circuit consists of compressors V102 and V104 and transient balance tubes V103 and V105. The compressor tubes control and maintain a constant amplitude of the signal fed into V109A. The transient balance tubes prevent spikes due to transients that occur in a normal compressor circuit without balancers. The compressors and the transient balance tubes operate on a d-c bias level determined by the amplitude of the signal fed into V109A. To obtain this bias the signal at the input to V109A is amplified in V106A, passed through cathode follower V106B, detected in diode detector V107A, and d-c amplified in V108. The output of V108 is used as d-c bias for the two compressor tubes and the two transient balance tubes.

4-12. The signal selected by switch S101E is fed through DEVIATION LEVEL control R119 to DEVIATION RANGE switch S102. The DEVIATION RANGE switch controls an attenuator network that reduces the input to cathode follower V110B. The output of V110B is the modulation deviation output of the audio unit and is fed through a filter in the r-f unit to the f-m unit.

4-13. The output of the DEVIATION LEVEL control is also fed through cathode follower V110A, amplifier V111A, and cathode follower V111B to peak detector V107B. Tube V107B is a diode detector that detects the peak value of the modulation deviation signal and passes a d-c signal proportional to this peak value on to vtvm tube V112. The vtvm tube has a d-c voltmeter in its cathode circuit. This voltmeter is the MODULATION DEVIATION meter and is calibrated in kilocycles of deviation. The meter has three scales (50, 150, and 300 kc) corresponding to the positions of the DEVIATION RANGE switch.

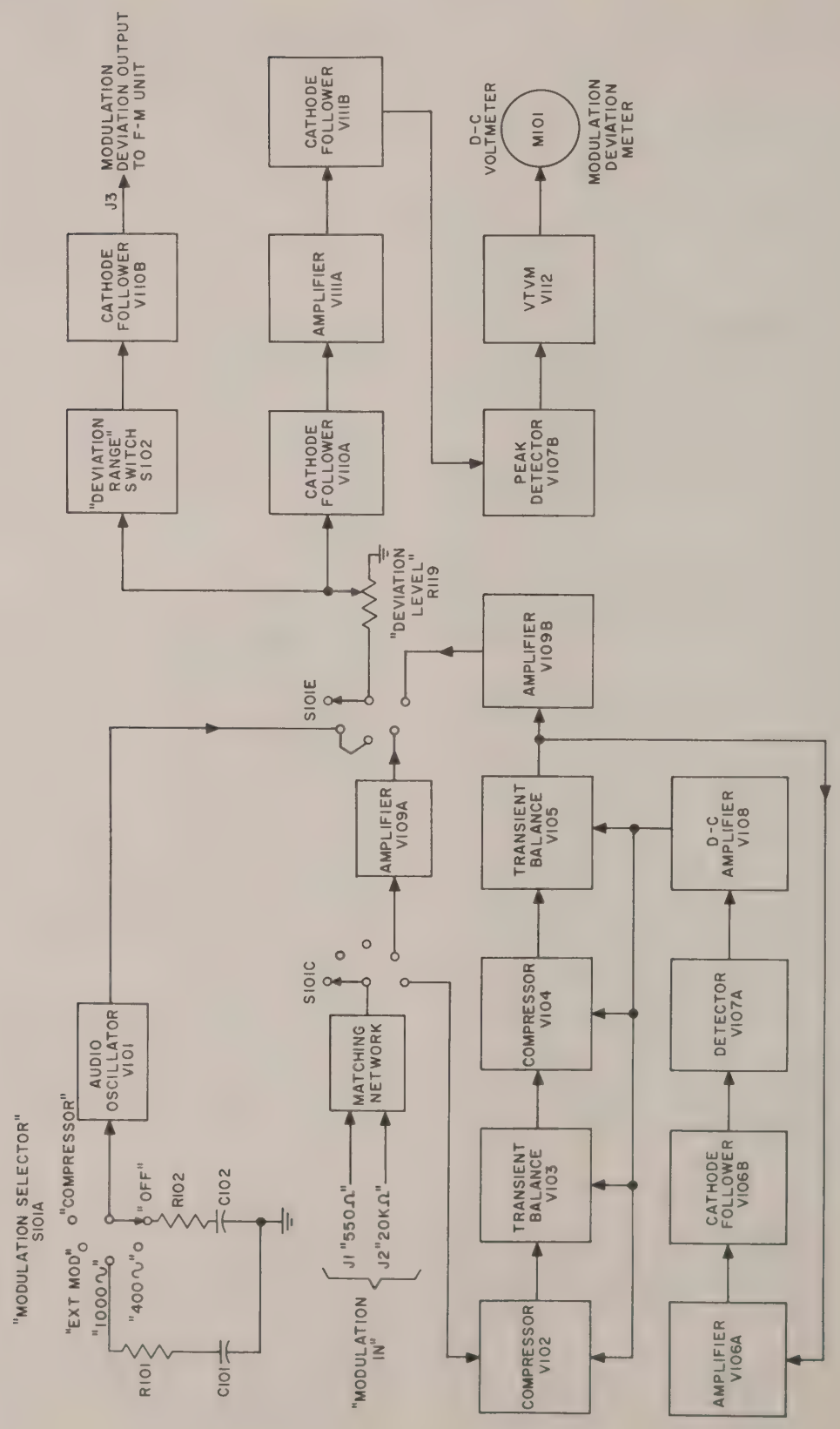


Figure 4-1. Audio Unit, Block Diagram

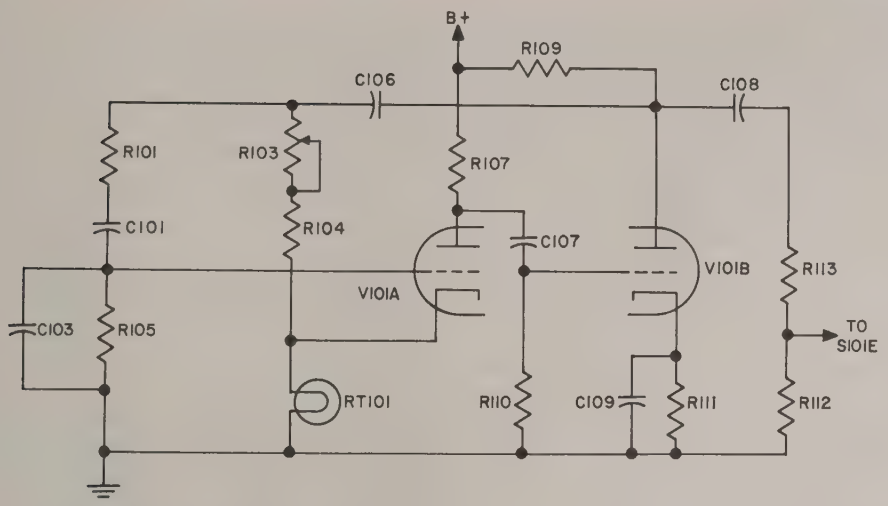


Figure 4-2. Wien Bridge (Audio) Oscillator, Simplified Schematic Diagram

4-14. WIEN BRIDGE (AUDIO) OSCILLATOR.

4-15. The Wien bridge oscillator consists of two resistance-capacitance-coupled amplifier stages and an unbalanced bridge network (Wien bridge). A simplified schematic diagram is shown in figure 4-2. For simplicity, MODULATION SELECTOR switch S101 has been omitted. Because of similarity in circuitry, only 1,000-cps operation is shown.

4-16. Triode tube section V101A acts as an oscillator and amplifier, and tube section V101B as a signal inverter. A random voltage transient appearing on the grid of V101A is amplified and inverted by that stage and is applied to the grid of V101B through coupling capacitor C107. It is further amplified and again inverted by V101B. A portion of the output of V101B is returned to the grid of V101A through C106, R101, and C101. Another portion of the output signal of V101B is returned to the cathode of V101A through C106, R103, and R104. The voltage fed back to the grid of V101A reinforces the initial signal (positive feedback), thereby causing oscillations to be set up and maintained. The voltage fed back to the cathode of V101A is degenerative (negative feedback), and tends to diminish oscillations. The unbalanced bridge circuit uses negative feedback signals to eliminate positive feedback voltages of all frequencies except 1,000 cps, the single frequency desired in the output.

4-17. The unbalanced Wien bridge circuit consists of four resistance-capacitance arms. The first arm, R101 and C101, and the second arm, R105 and C103, are the frequency-determining components of the oscillator and form a voltage divider which provides positive feedback for the oscillator. The third arm, R103 and R104, and the fourth arm, RT101, form a voltage divider providing negative feedback. Because there is no phase shift across the third and fourth arms (due to the absence of reactive components), and because the resistances in these two arms are practically constant for all frequencies, the amplitude of the negative feedback voltage is constant for all frequencies that may be present in the output of V101B. At 1,000 cps, the voltage across R105 (the input signal to V101A) is in phase with the output voltage of V101B, and the positive feedback voltage equals or barely exceeds the negative feedback voltage on the cathode. Oscillation is thereby sustained. Feedback voltages of any other frequency experience a phase shift in the first and second arms and are attenuated by the high degeneration of the circuit. The magnitude of negative feedback voltage thereby becomes greater than the positive feedback voltage and oscillation ceases. At a frequency higher than 1,000 cps, the reactance of C101 and C103 decreases and causes the voltage across R105, the grid voltage of V101A, to decrease below the value of the negative feedback. Oscillation ceases. At a frequency lower than 1,000 cps, the reactance of C101 increases, thereby decreasing the feedback current through the positive feedback voltage divider. The voltage drop across R105 decreases and the positive feedback to V101A falls below the value of the negative feedback. Oscillation ceases.

4-18. The output waveform of the oscillator is sinusoidal only at small amplitudes. Rheostat R103 is adjusted to optimize oscillator output versus waveform distortion. Thermistor RT101, used as the cathode resistor of V101A, serves to stabilize the amplitude of oscillation. If for some reason the amplitude of oscillation tends to increase, the current through RT101 tends to increase. When the current increases, the filament of RT101 becomes hotter, making its resistance larger. A greater negative feedback voltage is developed across the increased resistance of the hotter filament. Thus, more degeneration is provided, which reduces the gain of V101A and thereby holds the output voltage at a nearly constant amplitude.

4-19. The output of the oscillator is taken through coupling capacitor C108 across a voltage divider consisting of R113 and R112. This output is fed to switch S101E. With MODULATION SELECTOR switch S101 in the 400∩∪ position, the circuit is identical to that shown in figure 4-2 except for the components used in the first and second arms of the Wien bridge. In these arms, the values of the resistors and capacitors are changed to provide maximum positive feedback at 400 cps instead of at 1,000 cps.

4-20. EXTERNAL MODULATION INPUT CIRCUIT. External modulation may be fed into MODULATION IN jack J1 (560Ω) or J2 (20KΩ). A signal fed into J1 passes through R115 into S101C. A signal fed into J2 passes through R118 and R116 into S101C. Capacitors C110 and C111 provide high-frequency compensation so that signals up to 100 kc are passed without phase distortion. Resistors R114 and R117 are matching resistors to match the input impedance to 560 ohms and 20,000 ohms, respectively. With MODULATION SELECTOR switch S101 in the EXT MOD position, the external modulation is fed through S101C to amplifier V109B. With MODULATION SELECTOR switch S101 in the COMPRESSOR position, the external modulation is fed to the compressor circuit.

4-21. AUDIO AMPLIFIER V109A. The external-modulation signal is fed through S101C to the grid circuit of V109A. Capacitor C127 and resistor R158 in the grid circuit of V109A provide high-frequency compensation. Resistor R159 between the plate and grid circuits of V109A provides negative feedback for additional high-frequency compensation. The output of V109A is fed to S101E.

4-22. COMPRESSOR CIRCUIT. The compressor circuit consists of two compressor stages (V102 and V104), two associated transient balance stages (V103 and V105), the circuitry (V106, V107A, and V108) to provide a negative control voltage proportional to the input signal, and one amplifier stage (V109A). Each of the two compressor stages is an audio amplifier whose amplification factor is determined by the magnitude of the negative control voltage.

4-23. The external modulation signal is applied to the control grid of V102 through switch S101C and a voltage divider consisting of R121 and R120. The compressed and inverted output signal from V102 is coupled through C116 to the control grid of V104, where the signal is further compressed and again inverted. The output signal of V104 is coupled to V109A and to V106B.

4-24. The signal is coupled to the grid of audio amplifier V109A through the parallel combination of R143 and C122. Resistor R152 provides negative feedback across V109A to improve the high-frequency response of the circuit. The output of V109A is applied to switch S101E through C125 and is the compressor circuit output.

4-25. The output signal of V104 is also coupled through C119 and C120 to the grid of V106B, where the signal is amplified and again inverted. The output of V106B is directly coupled to the grid of cathode follower V106A. The output signal developed across cathode resistor R141 is applied to the cathode of peak detector V107A through C123. The signal is rectified and applied across an a-c filter consisting of C124 and a voltage divider (R144, R145, and R146). Potentiometer R145 applies part of the rectified voltage to a grid of direct-coupled, two-stage, d-c amplifier V108. The output voltage of V108 is applied to the suppressor grids of V102, V103, V104, and V105, through R148, R125, R130, and R134. Because of the circuit used, the d-c voltage applied to the suppressor grids becomes more negative when the amplitude of the external modulation signal increases, and becomes more positive when the amplitude of the external modulation signal decreases. As the amplitude of the external modulation signal increases, the cathode-to-plate conduction of V102 decreases due to the more negative voltage at the suppressor grid. The amplification of V102 thereby decreases. As the amplitude of the external modulation signal decreases, the cathode-to-plate conduction of V102 increases due to a less negative voltage at the suppressor grid. The amplification of V102 thereby increases. Varying the amplification factor of V102 thus maintains a constant-amplitude output signal. The compression process is repeated again in V104 to ensure a constant-amplitude output signal for large fluctuations in the amplitude of the external modulation signal.

4-26. Transient balance tubes V103 and V105 are used to prevent surges (sharp transients) in suppressor-grid voltage from appearing in the compressor-circuit output. As the amplitude of the external modulation signal increases abruptly, a negative surge occurs in the suppressor-grid voltage of V102, V103, V104, and V105, causing their plate currents to decrease and their screen-grid currents to increase. By cross-coupling the plates and the screen grids in each of the two compressor-transient balance stages, a decrease in plate current produces a corresponding increase in screen-grid current in that tube. Because the total current through the plate load resistors R124, R127, R131, and R135 remains virtually constant, transients in suppressor-grid voltage do not appear in the compressor-circuit output. Thus, the output waveform of both compressor stages remains undistorted when the amplitude of the external modulation signal fluctuates suddenly.

4-27. DEVIATION OUTPUT CIRCUIT. The deviation signal selected by MODULATION SELECTOR switch S101E is fed through DEVIATION LEVEL potentiometer R119 to an attenuator network controlled by DEVIATION RANGE switch S102. The output of S102 is coupled through C129 to the grid of cathode follower V110A. The output of V110A is the deviation output of the audio unit and is fed to the f-m unit.

4-28. MODULATION DEVIATION METERING CIRCUIT. A second output is taken from R119 through C128 to the grid of cathode follower V110B. The output developed across R165 and R166 in the cathode circuit of V110B is coupled through C130 to amplifier V111B. The amplified signal at the plate of V111B is direct-coupled to the grid of cathode follower V111A. The signal at the cathode of V111A is coupled through C131 to the plate of peak detector V107B. Tube V107B

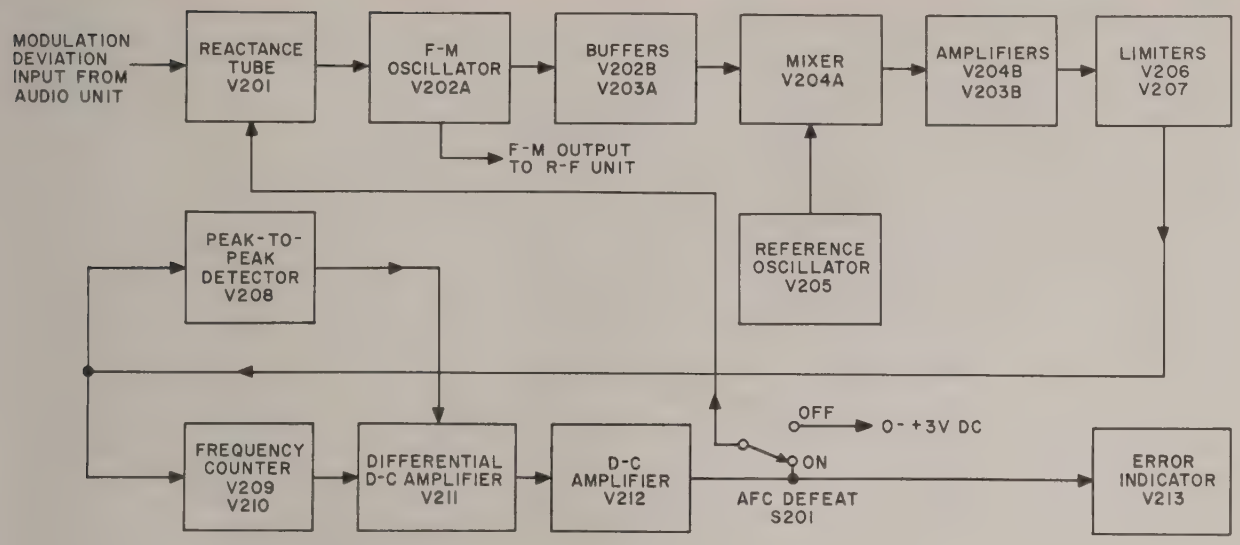


Figure 4-3. F-M Unit, Block Diagram

rectifies the modulation deviation signal and a d-c voltage, proportional to the average of the peaks in this signal, appears across the voltage divider consisting of R174, R176, and R177.

4-29. F-M UNIT. (See figure 7-2.)

4-30. GENERAL. Figure 4-3 is a block diagram of the f-m unit. The modulation deviation signal from the audio unit is fed into reactance tube V201. The reactance of V201 varies in accordance with the modulation deviation signal. The reactance tube is connected in the tank circuit of f-m oscillator V202A. Hence, the output of V202A is frequency modulated by the modulation deviation signal. The output of the f-m unit is taken from V202A and fed to the r-f unit.

4-31. The remaining circuits in the f-m unit are control circuits to stabilize the frequency of the oscillator and to give a visual indication that the oscillator's center frequency is correct.

4-32. A second output from V202A passes through grounded-grid buffer amplifiers V202B and V203A into mixer V204A. Reference oscillator V205, which is a 47.9-mc crystal-controlled oscillator, also works into mixer V204A. The output of V204A consists of the frequencies of the two oscillators, their sum and difference frequencies, and various harmonics and combinations of the above frequencies. These signals are passed on to amplifiers V204B and V203B and limiters V206 and V207.

4-33. The amplifiers and limiters can pass only frequencies up to several hundred kc and hence they pass only the difference frequency. The amplified and limited output of V207 is almost constant in amplitude and of a frequency proportional to the difference between the frequency of the reference oscillator and the frequency of the f-m oscillator.

4-34. The output of V207 is fed to a frequency counter consisting of V209 and V210 and to peak-to-peak detector V208. The frequency counter produces a voltage proportional to the difference frequency and to the amplitude of the applied signal. If this voltage were proportional only to the frequency difference, it could be used directly to regulate the frequency of the f-m oscillator. The two limiters, V206 and V207, and voltage regulators in the power supplies minimize changes in the frequency-counter output due to changes in the amplitude of the difference-frequency signal. However, there are slight changes in amplitude due both to changes in the amplitude of the difference signal and changes in the power-supply and filament voltages. Peak-to-peak detector V208 compensates for amplitude changes in the difference-frequency signal.

4-35. The peak-to-peak detector produces an output proportional only to the amplitude of the difference-frequency signal. The outputs of the peak-to-peak detector and the frequency counter are fed into differential d-c amplifier V211. When the amplitude of the difference signal changes, causing a change in the outputs of both the frequency counter and the peak-to-peak detector, there is no change in the output of the differential d-c amplifier. However, when the frequency of the difference signal changes, causing a change in the output of just the frequency counter, there is a change in the output of the differential d-c amplifier. This change is amplified by d-c amplifier V212.

4-36. The output of V212 is used to bias reactance tube V201. Changing the bias on V201 changes its reactance and hence changes the frequency of f-m oscillator V202A. With AFC DEFEAT switch S201 in the OFF position, the output of V212 is not connected to the reactance tube and the reactance tube is

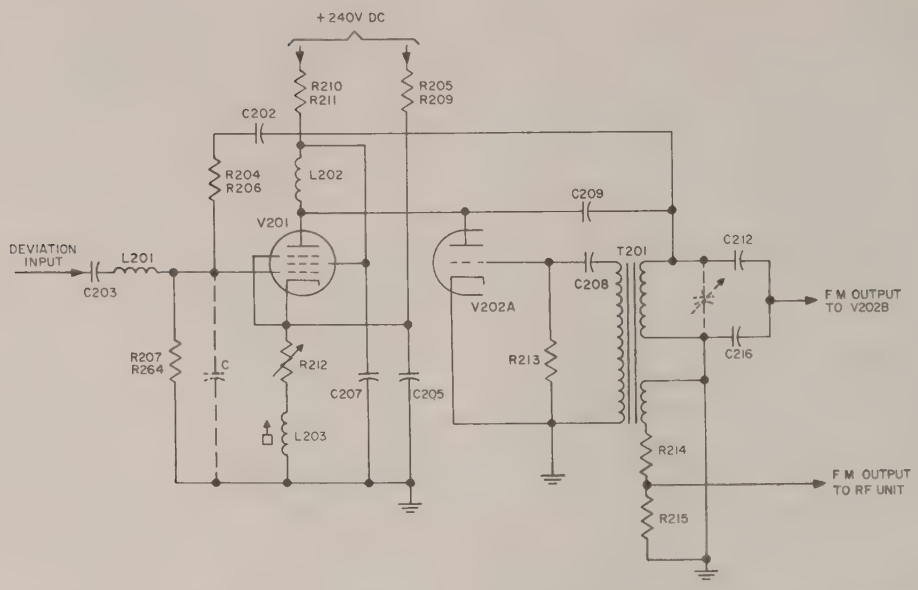


Figure 4-4. Reactance Tube Modulator and F-M Oscillator, Schematic Diagram

connected instead to a constant voltage. This provision is necessary for frequency calibration of the f-m oscillator since, with the frequency-control circuit activated, any change in the center frequency of the f-m oscillator would be corrected for by a change in the bias on V201.

4-37. The output of V212 is also fed to error indicator tube V516. Tube V516 is an electron ray indicator tube. When the frequency-control circuit is functioning properly and the f-m oscillator is on frequency, the indicating eye of V516 is halfway open. When the frequency-control circuit is not functioning properly or the f-m oscillator is off frequency, the indicating eye of V516 either opens all the way or closes. Thus V516 provides a visual indication of the operation of the frequency-control circuit and the f-m oscillator.

4-38. REACTANCE TUBE MODULATOR AND OSCILLATOR. Figure 4-4 is a simplified schematic diagram of the reactance tube modulator and oscillator circuits used in the f-m unit. Tube V202A is a 48-mc Butler oscillator. The output of the oscillator is modulated by reactance tube V102 which is parallel with the oscillator tank circuit.

4-39. Figure 4-4 shows tube V201 to be a conventional inductive-type, reactance-tube modulator. The grid-to-cathode capacitance C, together with the series combination of resistors R206 and R204, comprises the reactance-tube phase-shifting network. A portion of the bias for tube V201 is provided by the voltage divider consisting of parallel resistors R205 and R209 in series with cathode potentiometer R212. In addition, a correction bias is provided by the circuit which is described in paragraphs 4-42 through 4-54.

4-40. The modulation deviation signal from the audio unit enters the f-m unit through P508 and is applied through an r-f filter in the r-f unit, and through series capacitor and coil C203 and L201, to the control grid of reactance tube V201. The series combination of C203 and L201 isolates the audio circuit from the r-f voltage present in the reactance tube circuit. Slug-tuned coil L203 in the cathode circuit of V102 is used to correct the phase shift at 100 kc.

4-41. The f-m oscillator has two outputs. One is taken from the secondary of r-f transformer T201 and developed across a voltage divider consisting of R214 and R215. The portion of the signal developed across R215 is applied to the r-f unit through jack J201. The second output is taken directly from the plate tank circuit of V202A and developed across the voltage divider consisting of capacitors C212 and C216. The portion of the output developed across capacitor C216 is applied to the cathode input of grounded-grid buffer amplifier V202B. Capacitor C210 is a coarse adjustment of the natural frequency of the oscillator and capacitor C215 is the fine adjustment. Resistor R212 in the cathode circuit of tube V201 is used to adjust the bias of the reactance tube to obtain the proper center frequency of the modulated oscillator output.

4-42. BUFFERS, MIXER, AND REFERENCE OSCILLATOR. The frequency-modulated output of tube V202A passes through two conventional grounded-grid buffer amplifiers, V202B and V203A, and then is applied to the cathode of mixer tube V204A. Chokes L204 and L205, in the plate circuits of V202B and V203A, respectively, are slug-tuned to the center frequency of the f-m signal. Variable capacitors C220 and C224 are used for shunt peaking along with the plate loads of their respective amplifiers.

4-43. Reference oscillator V205 is a Butler oscillator and is crystal-controlled at a frequency of 49.7 mc.

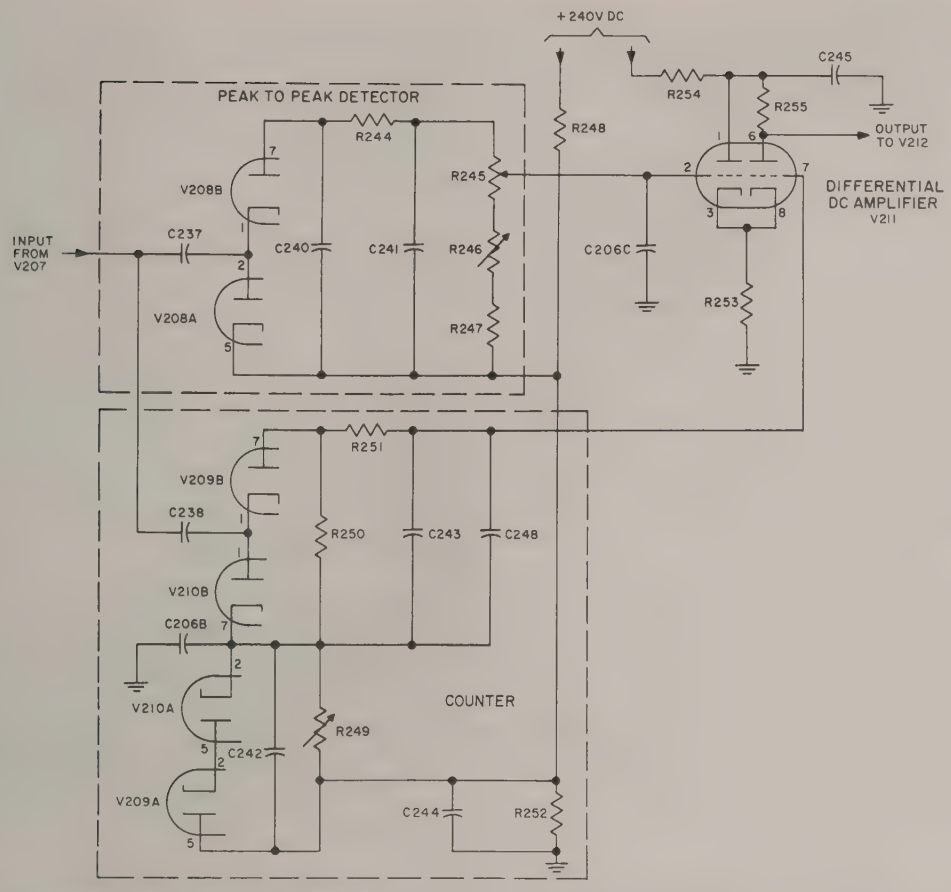


Figure 4-5. Peak-to-Peak Detector and Counter, Simplified Schematic Diagram

The B section of V205 is a grounded-grid amplifier with a tuned plate circuit. The A section is a cathode follower. The feedback loop between the two sections of the tube is from the B-section plate to the A-section grid through C230 and between the cathodes of the two sections through a crystal. The plate circuit of V205B is tuned to 49.7 mc, which is the third overtone frequency.

4-44. When plate voltage is applied to V205A, spurious oscillations excite the crystal to oscillation. The output of this crystal is rich in overtones and V205B amplifies the third overtone and couples it back to V205A. This feedback signal is sufficient to make the crystal oscillate at its third overtone. The output of the reference oscillator is taken from the plate of V205A and applied through P202 and J202 to the grid of mixer tube V204A.

4-45. There are, then, two signals applied to mixer tube V204A: the output of f-m oscillator V202A applied to the cathode, and the output of the reference oscillator applied to the grid. The output at the plate of V204A includes the two input frequencies and their sum and difference frequencies. However, the mixer stage is essentially a low frequency amplifier so that the two r-f input frequencies and the sum frequency are shunted to ground by the tube capacitance. The significant output of the mixer is therefore the difference signal of the two input frequencies. This difference signal is applied to the low-frequency amplifier and limiter stages.

4-46. AMPLIFIERS AND LIMITERS. The difference signal output of the mixer is passed through two audio amplifiers, V204B and V203B, and two limiters, V206 and V207. Amplifiers V204B and V203B are conventional class A amplifiers. Potentiometer R234 in the grid circuit of tube V203B provides a means of adjusting the 100-kc (i-f) wave shape symmetry.

4-47. Tubes V206 and V207 perform grid-cutoff limiting. Tube V206 limits the negative portion of the amplifier output and V207 limits the positive portion. The output of the limiters is a constant-voltage signal which is applied to the peak-to-peak detector and counter circuits.

4-48. FREQUENCY COUNTER. (See figure 4-5.) The output of amplifier V207 is applied to the counter circuit, V209B and V210B, through capacitor C238. Capacitor C238 is charged through V210B during

positive half cycles of the input signal. During negative half cycles, C238 discharges through V209B and develops voltage pulses across resistor R250. These pulses are impressed across the parallel combination of C243 and C248 in series with R251.

4-49. After several cycles, the two parallel capacitors charge to the average value of the pulsating voltage across R250. This action causes C242 to charge, and a d-c voltage is developed across rheostat R249 and diodes V209A and V210A. Diodes V209A and V210A conduct, causing C242 to discharge and the voltage across C242 to decrease. Simultaneously, C242 is charged by C243 and C248, so that an equilibrium between the charging and the discharging action is established. Increasing or decreasing the resistance of R249 causes the equilibrium voltage across C242 to increase or decrease, respectively. Rheostat R249 is used to adjust the value of negative output voltage of the frequency counter. Capacitor C206B maintains and therefore regulates the d-c voltage at the cathode of V210A and grounds the a-c component of the voltage.

4-50. An increase in the input frequency produces a greater pulse repetition rate across R250 and a corresponding increase in the average voltage across R250 and R249. Similarly, an increase in the amplitude of the input signal results in a corresponding increase in the average voltage across R250 and R249. The output of the counter is taken across parallel capacitors C243 and C248, and applied to a grid of differential d-c amplifier V211. The counter output is a negative voltage proportional to both the frequency and amplitude of the input signal.

4-51. PEAK-TO-PEAK DETECTOR. Peak-to-peak detector V208 is a conventional voltage doubler circuit that is used to produce a voltage proportional to the amplitude changes of the output of amplifier V207. The output of the peak-to-peak detector is a negative voltage developed across resistors R245, R246, and R247, and applied to a grid of differential d-c amplifier V211. Potentiometer R245 and rheostat R246 provide an adjustment of this output voltage.

4-52. DIFFERENTIAL D-C AMPLIFIER. Differential d-c amplifier V211 has two inputs. One input is the negative output of the peak-to-peak detector and the other is the negative output of the frequency counter. Tube V211 subtracts the two signals and produces an output that is proportional only to the frequency changes of the f-m oscillator and independent of the voltage changes appearing at the plate of V207.

4-53. The output of the frequency counter is applied to the grid of V211A. This output has two components: one proportional to oscillator frequency changes, and the other proportional to amplitude variations in the signal at the plate of amplifier V207. The output of the peak-to-peak detector, which is proportional only to the amplitude variations, is applied to the grid of V211B. Tube V211B is essentially a cathode follower, coupled by common cathode resistor R253 to V211A. As the voltage on the grid of V211B increases negatively, cathode current is decreased through R253 and the positive bias of the grid of V211A increases. Circuit constants are chosen so that the positive bias caused by the voltage on the grid of V211B is of the same magnitude but of opposite polarity to the component of the counter output that is proportional to amplitude. The amplitude component is therefore canceled, and only the frequency component of the counter output appears at the plate of V211A. Small variations in the 240-volt d-c line voltage do not affect the output of V211. Differential amplifier V211 provides output only when the two applied grid voltages differ and an increase (or decrease) in line voltage is applied simultaneously to both grids of V211. This output is applied to d-c amplifier V212.

4-54. D-C AMPLIFIER. The output of differential d-c amplifier V211 is applied to the grid of V212A. The B section of this tube is used in conjunction with potentiometer R262 to provide bias for the V212A section. The output of V212A is applied to the grid circuit of reactance tube V201, through potentiometer R260 and AFC DEFEAT switch S201. The effect of this variable bias, which is proportional to oscillator drift, is to correct for deviations of the oscillator about its center frequency.

4-55. ELECTRON RAY TUBE. The output from R260 is also taken through R201 and an r-f filter to electron ray tube V516. Tube V516 and its associated circuit are shown in figure 7-2 in dotted lines since they are physically in the r-f unit though they are functionally in the f-m unit. Tube V516 displays the correction voltage that is fed to the reactance tube. Potentiometer R506, in the cathode circuit of V516, adjusts the eye so that it is half open when the f-m unit is operating on frequency and opens fully or closes when the f-m unit is off frequency.

4-56. R-F UNIT. (See figure 7-3.)

4-57. GENERAL. Figure 4-6 is a block diagram of the r-f unit. Two oscillators in the r-f unit have their outputs fed into mixer V502. These are the tens oscillator and either the units oscillator or the interpolation oscillator, depending on the position of CALIBRATE VFO switch S501.

4-58. The frequency of tens oscillator V510 is determined by the selection of a crystal by the TENS frequency selector switch. The oscillator output frequency is between 9.500 and 18.875 mc. Each increase of ten in the position of the TENS frequency selector switch increases the frequency by 0.625 mc. Since there are four frequency doublers in the r-f unit (as will be seen in the following paragraphs), the output of the r-f unit will increase by 16 times 0.625 mc, or by 10.000 mc, each time the TENS frequency selector switch is moved up one number.

4-59. Units oscillator V511 is similar to tens oscillator V510. The frequency of the units oscillator is determined by the selection of a crystal by the UNITS frequency selector switch. The oscillator frequency is between 3.5000 and 4.0625 mc. Each increase of one unit in the position of the UNITS frequency selector switch increases the frequency by 0.0625 mc. Since there are four frequency doublers in the r-f unit, the output of the r-f unit increases by 16 times 0.0625 mc, or by 1.0000 mc, each time the UNITS frequency selector switch is moved up one number.

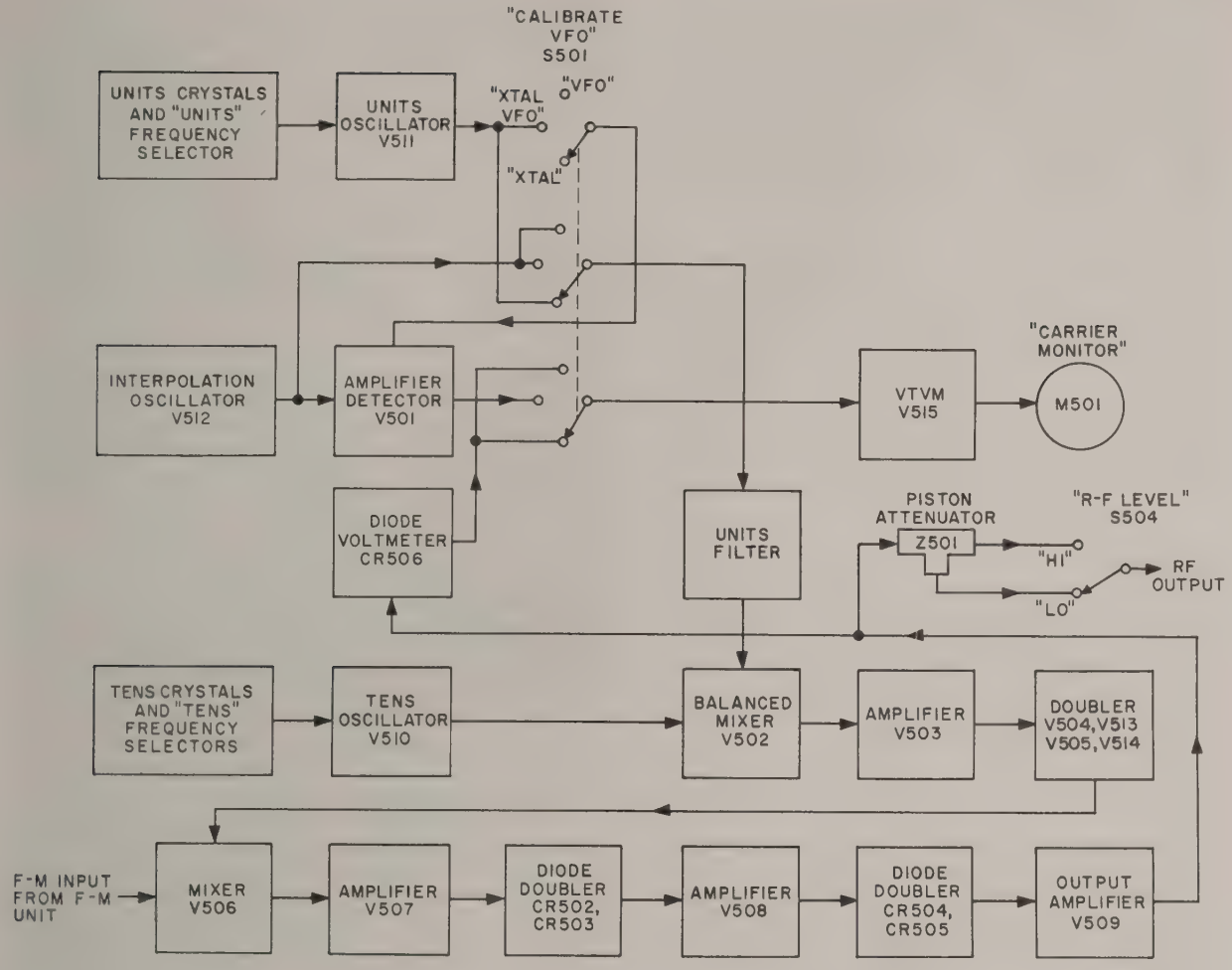


Figure 4-6. R-F Unit, Block Diagram

4-60. Interpolation oscillator V512 is a variable-frequency oscillator that covers the same frequency range as the units oscillator. The interpolation oscillator is used instead of the units oscillator when an output between unit frequencies is required. Provision is made (paragraph 4-67) to calibrate the interpolation oscillator at each megacycle of the output frequency.

4-61. The output of either units oscillator V511 or interpolation oscillator V512 passes through the units filter into mixer V502. Mixer V502 adds the frequencies of the two oscillators. For example, assume that the TENS frequency selector switch is set to 44 and the UNITS frequency selector switch is set to 8. Since 44 is the fifth position of the TENS frequency selector switch the output of the tens oscillator is then 9.500 + (4 x 0.625) or 12.000 mc. Similarly, since 8 is the ninth position of the UNITS frequency selector switch, the output of the units oscillator is 3.500 + (8 x 0.0625) or 4.0000 mc. The output of mixer V502 is then 16.000 mc. The following paragraphs explain how this 16-mc output of the mixer is converted to a 448-mc output from the r-f unit.

4-62. The output of the mixer is fed through amplifier V503 into two push-push doubler stages. Each of these stages uses two tubes. The first doubler consists of V504 and V513, while the second doubler consists of V505 and V514. The output of the second doubler is at four times the input frequency to the first. Hence, in the above example the output is 64 mc.

4-63. The output of the second doubler is fed into mixer V506. Mixer V506 mixes the signal from the second doubler with the output of the f-m unit. The output of the f-m unit is a frequency-modulated signal with a center frequency of 48 megacycles. The output of mixer V506 is the sum of the two inputs, 48 mc from the f-m unit and, in the example, 64 mc from the second frequency doubler. This output is an f-m signal with a center frequency of 112 mc.

4-64. The output of V506 passes through amplifier V507 into a full-wave diode doubler consisting of CR502 and CR503. The output of this doubler passes through another amplifier, V508, and another diode doubler, CR504 and CR505, into output amplifier V509. The output of V509 has four times the frequency of the signal fed into V507, or 448 mc in the example. This is the output frequency of the r-f unit and of the entire signal generator.

4-65. The output of V509 is fed into piston attenuator coupler Z501. The unit has two outputs. One output is fed directly through Z501 and is not attenuated while the other output is attenuated through the piston attenuator. Both outputs are fed into RF LEVEL switch S504 which is a coaxial switch. With S504 in the HI position, the full output of Z501 is the output of the r-f unit and the signal generator. With S504 in the LO position, the attenuated output of Z501 is the output of the r-f unit and of the signal generator.

4-66. The output of V509, in addition to feeding Z501, is sampled by diode voltmeter CR506. The diode voltmeter rectifies part of the output of V509 and feeds this rectified signal to a set of contacts on CALIBRATE VFO switch S501. With S501 in either the VFO position or the XTAL position this signal passes through the switch to vtvm tube V515. The vtvm tube has a d-c voltmeter in its cathode circuit. This voltmeter is the CARRIER MONITOR meter.

4-67. With CALIBRATE VFO switch S501 in the XTAL + VFO position, the CARRIER MONITOR meter is used to calibrate the interpolation oscillator. The output of interpolation oscillator V512, in addition to being fed to S501, is fed to amplifier detector V501. A crystal diode in the plate circuit of V501 detects the combined signal. The output is taken through the crystal and contacts of S501 in the XTAL + VFO position to vtvm tube V515. Thus a combination of the outputs of the units and interpolation oscillators is read on CARRIER MONITOR meter V501. By adjusting the frequency of the interpolation oscillator the meter can be made to show a zero beat between the two frequencies. This indicates that the frequency of the interpolation oscillator is within a few cycles per second of the frequency of the crystal-controlled units oscillator.

4-68. TENS OSCILLATOR. The tens oscillator, tube V510, is an electron-coupled, modified Colpitts oscillator utilizing a crystal in place of the conventional tank circuit. An output of from 9.5000 to 18.8750 mc is obtained in 16 steps by the selection of crystals Y501 through Y516 by TENS frequency selector switch S506B. The range of the tens oscillator makes it necessary to change the plate load for every second step of the oscillator frequency. Plate-load switching is provided by switch S506A. The output of the tens oscillator is coupled through C579 to the second signal grid of balanced mixer tube V502.

4-69. The units oscillator, tube V511, is essentially the same as the tens oscillator. A frequency range of from 3.5000 to 4.0625 mc is obtained in 10 steps by the selection of crystals Y517 through Y526 by UNITS frequency selector switch S505. The output of the units oscillator is applied across R541 and the primary winding of T501. The parallel combination of R541 and T501 form a broad-tuned or low-Q output circuit which is resonant within the 3.5000 to 4.0625 mc band of frequencies. The secondary of transformer T501 applies the output of V511, through contacts of operation selector switch S501 in the XTAL position, to the units filter. The units filter consists of chokes L561 through L565, capacitors C653 through C656 and C658 through C660, and resistors R549, R550, R551, and R558. The output of the units filter is fed to the first grid of balanced mixer V502.

4-70. INTERPOLATION OSCILLATOR. Interpolation oscillator V512 is a variable-frequency, electron-coupled, Clapp oscillator that covers the same frequency range as the units oscillator. The output of this oscillator is taken from the secondary of broadly tuned transformer T502, through J507 and P507 and an attenuator consisting of R542, R543, and R544, to the first grid of mixer V502 when switch S501 is set to the VFO position. Frequency selection is accomplished by setting the UNITS selector, which is ganged with variable capacitor C615 in the oscillator tank circuit. With S501 in the VFO position, the UNITS selector moves freely and can be set between integral megacycles.

4-71. The interpolation oscillator may be calibrated at each integral megacycle step of the units oscillator when switch S501 is set to the XTAL + VFO position. At this switch position, the output of the crystal-controlled units oscillator is applied to the cathode input of amplifier detector V501, while the output of the interpolation oscillator is always applied to the control grid of V501. The output of the amplifier detector contains the two input frequencies plus their sum and difference. These signals are rectified by diode CR501 in the output circuit of V501, and then fed through S501 and filtered by the two-section pi filter consisting of chokes L509 and L510 and capacitors C505, C511, and C517. The output of this filter is the difference between the interpolation oscillator and the units oscillator frequencies. This signal is applied through pins H of J511 and P504, S507 and pins E of J405 and P510 to vtvm tube V515. The interpolation oscillator is calibrated by adjusting CALIBRATE VFO control C613 until a near-zero beat is observed on the CARRIER MONITOR meter.

4-72. CARRIER MONITOR VTVM. The carrier monitor vtvm tube V515 is a conventional balanced-amplifier meter circuit. Potentiometer R507, between the plates of the double triode, is the ZERO SET control on the front panel. Potentiometer R501 in the grid circuit of V515A provides a means of sensitivity control, while potentiometer R503 in the cathode circuit of V515B is the coarse zero control. CARRIER MONITOR meter M501 is connected between the two cathodes of V515.

4-73. MIXER V502. Mixer tube V502 combines the outputs from the tens oscillator and either the interpolation oscillator or the units oscillator. The output

of the mixer is taken across the capacitive leg of a shunt-tuned circuit consisting of coil L549 and the parallel combination of variable capacitors C557 and C558. This circuit is tuned to resonance at the sum frequency of the two input signals to the mixer. This sum signal is applied to the grid of amplifier tube V503.

4-74. AMPLIFIER AND FIRST DOUBLER. The sum signal output of the mixer is amplified by tube V503 and applied to the primary of T503. Transformer T503 serves as a phase inverter at the input of the push-push doubler tubes, V504 and V513. The plates of tubes V504 and V513 are tied together so that a signal of twice the input frequency appears across the primary of transformer T504. The output circuit of the first doubler is a tuned circuit consisting of the primary of coupling transformer T504 shunted by the parallel combination of variable capacitors C565 and C566. The secondary of T504 serves as a phase inverter for the second doubler.

4-75. SECOND DOUBLER AND MIXER. The second doubler, tubes V505 and V514, is similar to the first doubler. The common plate load for both tubes is coil L574. Variable capacitors C567 and C568 form a parallel tuned circuit with L574 which is tuned to resonate at four times the input frequency of the first mixer. The output of the second doubler is applied to the second signal grid of mixer V506.

4-76. Also applied to mixer V506 is the f-m signal from the f-m unit. The f-m signal enters the r-f unit through P503, P502, and J501, and is applied to the center tap of autotransformer T507. The signal developed across the whole transformer winding is then applied through C621 to the first grid of mixer V506. The output of V506 is the combination of its two input signals plus their sum and difference frequencies. The combination of variable capacitors C569 and C570 forms a parallel resonant circuit with coil L546 which is tuned to the sum frequency appearing at the plate of V506. The output of V506 is coupled through C571 and R519 to the grid of amplifier V507.

4-77. AMPLIFIERS AND DIODE DOUBLERS. Tube V507 is a conventional amplifier utilizing a shunt-tuned plate circuit consisting of variable capacitors C572 and C573 in parallel with the primary of transformer T505. The output of mixer V506 is amplified by V507 and applied to the diode doubler consisting of the secondary of T505 and crystal diodes CR502 and CR503. Essentially this circuit is an unfiltered full-wave rectifier with a pulsating output of twice its input frequency. Potentiometer R537 provides a means of indirectly adjusting the amount of signal applied from the output of the diode doubler to the input of grounded grid amplifier V508, by optimizing the d-c bias on the diodes, CR502 and CR503.

4-78. The output circuit of amplifier V508 is series-tuned and transformer-coupled to another diode doubler consisting of transformer T506 and crystal diodes CR504 and CR505. Variable capacitors C574 and C575 tune the output circuit of V508 to twice the output frequency of the previous amplifier.

4-79. OUTPUT AMPLIFIER AND PISTON ATTENUATOR. The final output amplifier, tube V509, is of the grounded-grid type. Plate voltage is applied to V509 through POWER SET potentiometer R428. This control is ganged with switch S507 and at the extreme counterclockwise position of the POWER SET control, S507 is opened and the input to the carrier monitor circuit is disconnected so that the CARRIER MONITOR meter can be zero-set. Coil L576, together with variable capacitors C577 and C578, forms a series resonant circuit at the plate of V509. The output of this stage is coupled to the piston attenuator by a secondary loop around coil L576.

4-80. Piston attenuator Z501 consists of a section of coaxial line with a waveguide entering one wall perpendicular to the longitudinal axis of the line. The coaxial line is designed to propagate the output frequency band of the r-f unit, while the waveguide, or stem portion, is designed to attenuate these frequencies. The lower end of the waveguide is fitted with a rack and pinion which may be moved longitudinally up and down the waveguide. The pinion is connected to the front-panel ATTENUATOR control. Inside the stem and attached to the rack is a pickup loop which is electrically connected through the rack to the coaxial switch by a coaxial cable.

4-81. The input signal to the piston attenuator is applied to jack J505A. Most of the signal appearing at J505A is propagated through the coaxial line to J505B. The output at this jack is not appreciably attenuated. A portion of the r-f energy passing through the coaxial line enters the waveguide but this portion of the signal is attenuated rapidly as it advances into the waveguide. If the rack is moved into the attenuator by the turning of the ATTENUATOR control, so that the loop is brought near the junction of the waveguide and the coaxial line, the loop picks up a signal that is only slightly attenuated. If, however, the rack is moved down the waveguide, the loop retreats from the junction and picks up a signal that is greatly attenuated. The amount of attenuation in db of this circuit is proportional to the distance between the loop and the upper section of the coaxial line.

4-82. The output of the attenuator is taken from the terminal on the end of the cable that goes through the rack and applied to coaxial switch S504. When S504 is set to the LO position, the output from this terminal is applied to RF OUTPUT jack J506. If attenuation is not required, switch S504 is set to the HI position and the signal from jack J505B is applied directly to J506.

4-83. Crystal diode CR506, between J504A and J504B, samples and rectifies a small portion of the output of V509. The rectified sample is applied, through S501 in the XTAL or VFO position, an r-f filter, P511 and J404, S507, and J405 and P510, to vtvm tube V515. The output is thus indicated on CARRIER MONITOR meter M501 as explained in paragraph 4-45.

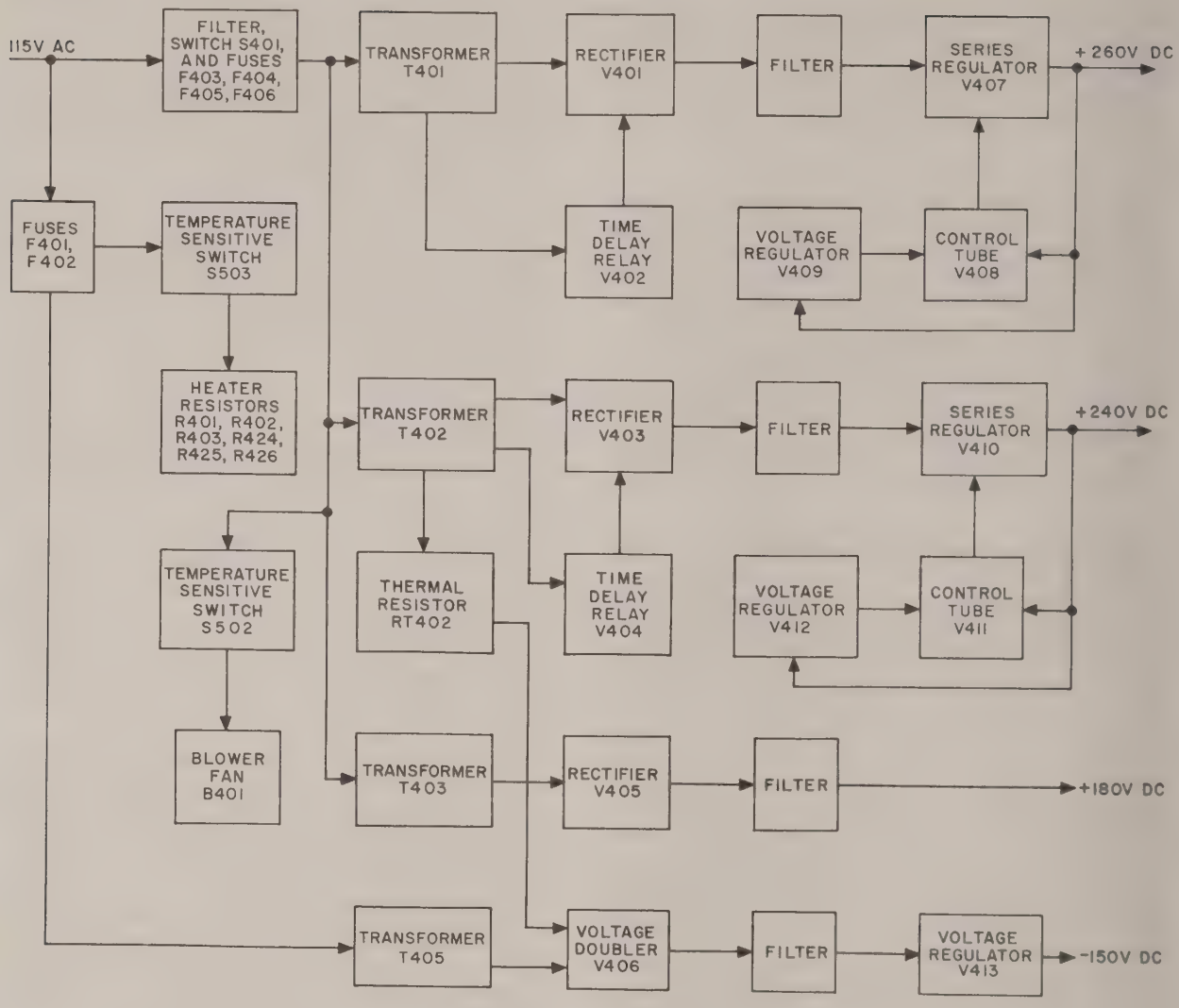


Figure 4-7. Power Supplies, Block Diagram

4-84. POWER SUPPLIES. (See figures 4-7 and 7-4.)

4-85. GENERAL. The power supplies include two +240-volt, d-c regulated power supplies, a -150-volt, d-c regulated power supply, a +180-volt, d-c unregulated power supply, filament supplies for all of the tubes in the signal generator, and a 28-volt, a-c power supply. In addition, a-c power is provided for heaters in the crystal ovens in the r-f unit, and a blower and heaters are included to control the temperature inside the signal generator.

4-86. INPUT POWER. The 115-volt, 50- to 420-cps power input to the signal generator is fed through POWER INPUT receptacle J401 to a dual-pi line-noise filter consisting of inductors L404 and L405 and capacitors C414, C415, C416, and C417. The two inductors present a high impedance to high-frequency line noise and the noise does not propagate further into the supply. The capacitors remove the high-frequency noise from the line by passing the noise to ground. The 115-volt power input is then applied to power switch S401. Regardless of the position of S401, power is supplied through LINE fuses F401 and F402 to T405 and also, through a thermostat, to heater resistors R401, R402, R403, R424, R425, and R246. The secondary of T405 feeds the heaters in the crystal ovens in the r-f unit through pin S of J404 and also supplies power for the -150-volt, d-c regulated power supply. However, the -150-volt, d-c regulated power supply does not receive filament power with S401 in the HEATER position. With S401 in the ON position, all of the circuits discussed in the following paragraphs are activated.

4-87. +240-VOLT REGULATED D-C POWER SUPPLIES AND BLOWER. With S401 in the ON position, power is fed through LINE fuses F403 and F404 and connectors J406 and P406 to transformers T401 and T402. Power is also fed through F403 and F404 to blower B401. The blower is connected through a thermostat and, in conjunction with the heaters, keeps the signal generator at the proper operating temperature. Transformers T401 and T402 supply pwoer to the +240-volt regulated d-c power supplies. Since the two power supplies are identical only the one receiving its power from T401 will be discussed in the following paragraphs.

4-88. Tube V401 is connected as a full-wave rectifier. Tube V402 is a thermal time-delay relay that delays the application of filament power to V401 until the filaments of the tubes in the audio, f-m, and r-f units have warmed up. This prevents the application of plate power to the tubes while their filaments are still cold. When V402 closes, power is supplied to the filament of V401 and the rectified output of V401 is filtered by a pi-section filter, consisting of C401, C406, and L401, and fed through series regulator tube V407. The output at the cathodes of V407 is the 240-volt output. The output of this power supply is fed through pins N of P406 and J406 and pin A of J407 to the audio unit. This output is also fed through pin B of J404 to the r-f unit. The output of the second +240-volt regulated d-c power supply if fed through pins D of P406 and J406 and through pin A of J405 and pin D of J404 to the r-f and f-m units, respectively. The output of the second +240-volt regulated d-c power supply is also fed through potentiometer R428 to provide plate power for output amplifier V509 in the r-f unit. Potentiometer R428 is the front-panel POWER SET control. Switch S507, ganged with R428, opens when R428 is in the extreme counterclockwise position. This switch disconnects the signal from vtvm tube V515 in the r-f unit so that CARRIER MONITOR meter M501 can be zero set.

4-89. If there is a rise in the 240-volt output, due to a reduction in the current drawn from the power supply or a rise in the line voltage, R419 in a voltage-divider circuit between the 240-volt output and ground feeds part of this rise to the control grid of control tube V408. The cathode of V408 is kept at a constant voltage by voltage regulator tube V409. Therefore, the voltage at the plate of V408 drops, and this drop is more than the rise on the grid, due to the amplification of the tube. The plate of V408 is direct-coupled to the grids of V407. Hence, the grid voltage on V407 goes down. A decrease in grid voltage on V407 effectively increases the plate-to-cathode resistance of the tube and, thus, restores the cathode voltage to +240 volts. Similarly, if the 240-volt output goes down, due to an increase in the load current or a decrease in line voltage, the circuit again restores the output to 240 volts. Potentiometer R419 is an output voltage control since it controls the voltage on the grids of V407.

4-90. +180-VOLT UNREGULATED D-C AND 28-VOLT A-C POWER SUPPLIES. With S401 in the ON position, power is also fed through LINE fuses F405 and F406 and through connectors J406 and P406 to transformers T403 and T404. The secondary voltage from transformer T404 passes through P406 and J406 to light I401, which is the front-panel pilot light of the signal generator, and to supply 28-volt a-c power to PWR OUTPUT receptacle J403 for use in associated equipment. The output of T403 feeds full-wave rectifier tube V403. The rectified output of V403 is filtered by a one-section filter consisting of L403 and C403 and is the +180-volt output of the rectifier. This output is fed through pins J of P406 and J406 and PWR OUTPUT receptacle.

4-91. -150-VOLT REGULATED D-C SUPPLY. As was explained in paragraph 4-86, transformer T405 in the -150-volt, regulated d-c supply receives power regardless of the position of switch S401. However, the filament of V406 gets its power from T402 through P406 and J406 and, hence, the power supply only functions with S401 in the ON position. Tube V406 is a voltage doubler. During half cycles when terminal 3 of T405 is positive C404 charges through V406B. When terminal 4 becomes positive the voltage on the secondary of T405 is added to the voltage on C404 and an output of almost double the input voltage passes through V406A and appears across filter capacitor C405. Capacitors C405 and C413 and potentiometer R408 form a pi-section filter. Voltage regulator tube V413 keeps the output of the supply at -150 volts, regardless of small changes in the line voltage or the load current on the supply. Potentiometer R408 is used to adjust the output of the supply so that, under normal conditions, V413 conducts approximately 25% of its maximum current or 7 ma. The output is fed through pin B of J407 to the audio unit and through pin E of J404 to the f-m unit.

SECTION V

ORGANIZATIONAL MAINTENANCE

5-1. GENERAL.

5-2. Organizational checks and repairs are made to keep Signal Generator AN/ARM-24 in good operating condition. An inspection schedule is given in paragraph 5-14. Repairs will be limited to the replacement of faulty parts (such as fuses and the pilot lamp). Organizational maintenance personnel may also replace the entire signal generator. More involved repairs (including the unsoldering of parts, the replacement of tubes, and any adjustments) should not be attempted.

5-3. MINIMUM PERFORMANCE STANDARDS.

5-4. Table 5-1 gives the system minimum performance standards for Signal Generator AN/ARM-24. The procedure for checking minimum performance of Signal Generator AN/ARM-24 is performed with the signal generator connected to a proper source of power as follows: Connect cord CX-3135/U from power input connector J401 to a suitable power source (see table 3-10. A 50-ohm dummy load resistor and a source of modulation between 300 cycles and 100 kilocycles from 0.8 to 6 volts is also required. Some observations in the minimum performance standards table are made by noting indications on the equipment, such as the lighting of the pilot lamp, the position of the shadow on the electron-ray tube indicator, and the readings of the meters. If the equipment does not meet the minimum performance standards, perform a system trouble analysis, as described in paragraphs 5-5 through 5-7, to remedy the trouble.

5-5. SYSTEM TROUBLE ANALYSIS.

5-6. All trouble analysis should be limited to locating defective fuses or pilot lamp. All other trouble analysis is beyond the scope of organizational maintenance personnel, since it requires replacement of tubes and parts and would therefore necessitate realignment of the signal generator. When blown fuses are suspected as the cause of trouble, such fuses can be checked with an ohmmeter or by substitution. The pilot lamp can be checked in a similar manner.

TABLE 5-1

SYSTEM MINIMUM PERFORMANCE STANDARDS

Step	Procedure	Indication
1	Set power switch S401 to the HEATER position and allow 1 hour for warmup; then move power switch S401 to the ON position and allow the signal generator to warm up for another 10 minutes.	Power-on lamp I401 lights.
2	Push TUNE AFC control S201-C215 in as far as it will go and rotate it fully counterclockwise, then slowly clockwise to the point where the electron-ray tube (V516) indication just "opens". Release TUNE AFC control S201-C215 at the precise moment of the "eye-open" indication.	When the TUNE AFC control S201-C215 is released, the "eye-open" indication will revert to a "half-open" indication.
3	Set operation selector switch S501 to the XTAL+VFO position.	None.

TABLE 5-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Procedure	Indication
4	Set the TENS and UNITS selector dials within 1 mc of an operating frequency for test purposes.	None.
5	Rotate ZERO SET control R507 of CARRIER MONITOR meter M501 to adjust meter zero.	CARRIER MONITOR meter M501 zeros to extreme left-hand mark.
6	Rotate CALIBRATE VFO control C613 to its full counterclockwise position, then slowly rotate the control in a clockwise direction while observing CARRIER MONITOR meter M501.	The needle of CARRIER MONITOR meter M501 should move to the right and then begin to drop back to the left, vibrating as it does so. The UNITS control S505-C615 is now free to move 1 mc to either side of the calibration point.
7	Terminate RF OUTPUT jack J506 with a suitable 50-ohm load.	None.
8	Position RF LEVEL control S504 to HI by pulling the control out, turning, and then pushing it back in.	CARRIER MONITOR meter M501 reading increases.
9	Rotate POWER SET control S507-R428 until CARRIER MONITOR meter M501 reading is set to the extreme right-hand mark.	CARRIER MONITOR meter M501 reading remains at extreme right-hand mark.
10	Position RF LEVEL control S504 to LO by pulling the control out, turning, and then pushing it back in.	CARRIER MONITOR meter M501 reading does not change.
11	Rotate POWER SET control S507-R428 until CARRIER MONITOR meter M501 reading is set to the red line.	CARRIER MONITOR meter M501 reading remains at red line.
12	Rotate ATTENUATOR control Z501 until the associated dial indicates the desired output.	ATTENUATOR dial indicates desired output in microvolts and db below 1 milliwatt.
13	Rotate ZERO SET control R180 of MODULATION DEVIATION meter M101 to adjust meter zero.	MODULATION DEVIATION meter M101 reading is zeroed.
14	Set MODULATION SELECTOR switch S101 to 400∿ position.	MODULATION DEVIATION meter M101 reading changes in accordance with position of DEVIATION LEVEL control R119.
15	Set DEVIATION RANGE switch to 50 position.	MODULATION DEVIATION meter M101 reading changes in accordance with position of DEVIATION LEVEL control R119.
16	Rotate DEVIATION LEVEL control R119 from its fully counterclockwise position to fully clockwise.	MODULATION DEVIATION meter M101 reads from zero to 50.

TABLE 5-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Procedure	Indication
17	Repeat steps 15 and 16 with DEVIATION RANGE switch S102 set to 150, and then repeat the same steps with the DEVIATION RANGE switch set to 300.	MODULATION DEVIATION meter M101 reads from zero to 150 and then from zero to 300.
18	Repeat steps 15, 16, and 17 with MODULATION SELECTOR switch S101 set to 1000∿ position.	MODULATION DEVIATION meter M101 reading varies from zero to full scale in accordance with position of DEVIATION LEVEL control R119 for each setting of DEVIATION RANGE switch S102.
19	Set MODULATION SELECTOR switch S101 to EXT MOD position.	MODULATION DEVIATION meter M101 reads zero.
20	Connect a source of external modulation voltage to either MODULATION IN 560Ω jack J101 or to MODULATION IN 20KΩ jack J102 according to the impedance of the modulation source. The modulation voltage should be between 0.8 and 6 volts from 300 cycles to 100 kilocycles.	MODULATION DEVIATION meter M101 reading changes in accordance with position of DEVIATION LEVEL control R119.
21	Repeat steps 15, 16, and 17 for different input modulation voltages and frequencies within the range given in step 20.	MODULATION DEVIATION meter M101 reading varies from zero to full scale in accordance with position of DEVIATION LEVEL control R119 for each setting of the DEVIATION RANGE switch S102.
22	Set MODULATION SELECTOR switch S101 to COMPRESSOR position and vary input modulation voltage between 0.8 and 6 volts, from 7000 to 80,000 cycles.	MODULATION DEVIATION meter M101 reading remains constant with input modulation voltage and frequency change.
23	Repeat steps 15, 16, and 17 with MODULATION SELECTOR switch S101 in COMPRESSOR position.	MODULATION DEVIATION meter M101 reading changes in accordance with position of DEVIATION LEVEL control R119 for each setting of DEVIATION RANGE switch S102.

5-7. REMOVAL AND REPLACEMENT.

5-8. GENERAL. Complete instructions for uncrating, crating, and reshipment of the signal generator are given in Section III of this handbook. Follow those parts of the instructions that are pertinent.

5-9. FUSES AND PILOT LAMP. The fuses used in the signal generator are listed in table 1-3 with their types and rating. Be sure to replace all fuses with those of identical rating. The pilot lamp (I401) is a Westinghouse Type 313 (or equivalent), and can be replaced by removing the lampholder jewel.

5-10. MINOR REPAIR AND ADJUSTMENT.

5-11. Except for the replacement of fuses or the pilot lamp, outlined in paragraph 5-7, organizational maintenance personnel are not authorized to make repairs. No adjustments of any kind may be made.

5-12. LUBRICATION.

5-13. No lubrication is to be performed by organizational maintenance personnel.

5-14. INSPECTION SCHEDULE.

5-15. Table 5-2 is an inspection schedule for the signal generator. The inspection should be performed at the intervals indicated to keep the equipment in proper working order.

TABLE 5-2

SIGNAL GENERATOR AN/ARM-24 INSPECTION SCHEDULE

Inspection	Corrective Measures	Time
Minimum performance standards. See table 5-1.	Trouble Analysis. See paragraph 5-5.	Before use.
Inspect meter windows and electron-ray tube for dirt.	Clean with damp lint-free cloth. Use soap if oil or grease is present.	Weekly.
Check for scratches and chipped paint.	Apply light gray semi-gloss enamel, Specification MIL-E-15090 to chipped or scratched surfaces.	When necessary.
Inspect for dust, dirt, and obstructed air passages in louvers.	Clean with stiff brush.	Weekly.

SECTION VI

FIELD MAINTENANCE

6-1. GENERAL.

6-2. Whenever Signal Generator AN/ARM-24 is found to be defective, and the repair is beyond the scope of organizational maintenance personnel, field maintenance personnel will make checks, tests, and adjustments to isolate and repair the trouble. Maintenance and repair beyond that which can be performed using the test equipment, tools, and spare parts available is not authorized.

6-3. MINIMUM PERFORMANCE STANDARDS.

6-4. The checks, tests, and adjustments outlined in tables 6-1 through 6-5 indicate whether the signal generator and its major assemblies meet minimum standards of performance. If these standards cannot be met, refer to the applicable trouble analysis chart (tables 6-6 through 6-10). Once the fault has been corrected, consult the minimum performance standards tables for the repaired assembly and for the signal generator.

WARNING

Voltages present in Signal Generator AN/ARM-24 are dangerous to life and may prove fatal. Observe all safety precautions. Be sure to remove all power before servicing the equipment.

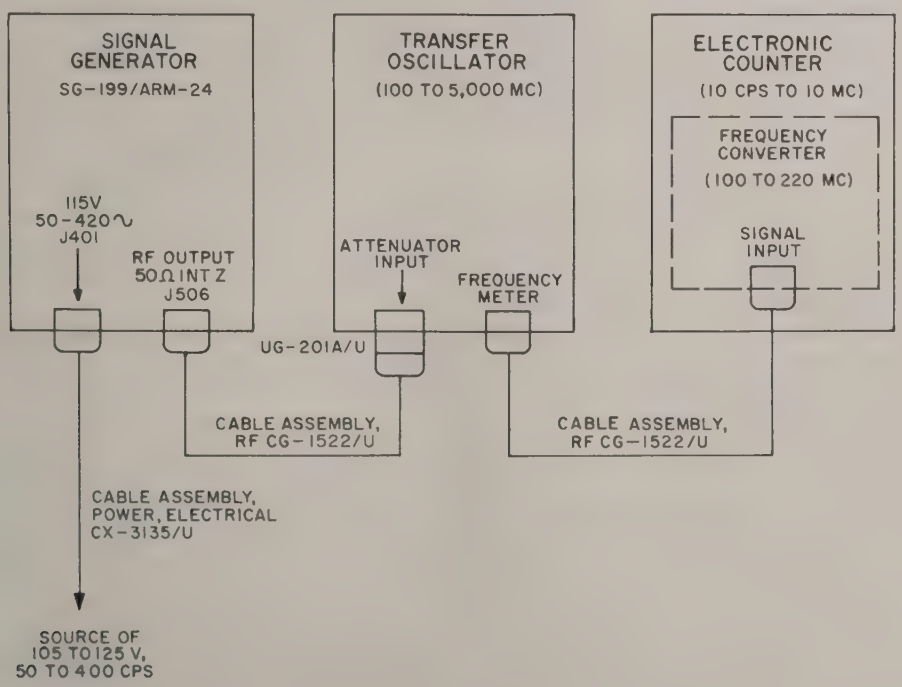


Figure 6-1. R-F Frequency Accuracy Test

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
1	Frequency accuracy test: Connect Signal Generator SG-199/ARM-24 to the following test equipment as shown in figure 6-1: transfer oscillator (100 to 5000 mc) and electronic counter (10 cps to 10 mc) with frequency converter (100 to 200 mc). Set controls as follows: Signal Generator SG-199/ARM-24 Control — Setting DEVIATION RANGE (S102) — Any DEVIATION LEVEL (R119) — Any MODULATION SELECTOR (S101) — OFF Operation selector switch (S501) — XTAL RF LEVEL (S504) — HI HEATER position for at least 12 hours and then in ON position for at least 1 hour before remainder of test. Power switch (S401) POWER SET (R428, S507) — Zero CARRIER MONITOR meter (M501) and adjust control for reading at red line. Transfer Oscillator Control — Setting Attenuator — Approximately 40 db Power Switch — ON (Attenuator output to mixer input B and mixer input A to oscillator output.) Electronic Counter Control — Setting Function — Frequency Frequency unit — 10 sec Display time — As required 1000 kc frequency standard — Internal	Computed frequency corresponds to frequency dial setting of signal generator accurate to ±0.002 percent for integral mc points and accurate to ±0.01 percent for intermediate points.	See table 6-4.

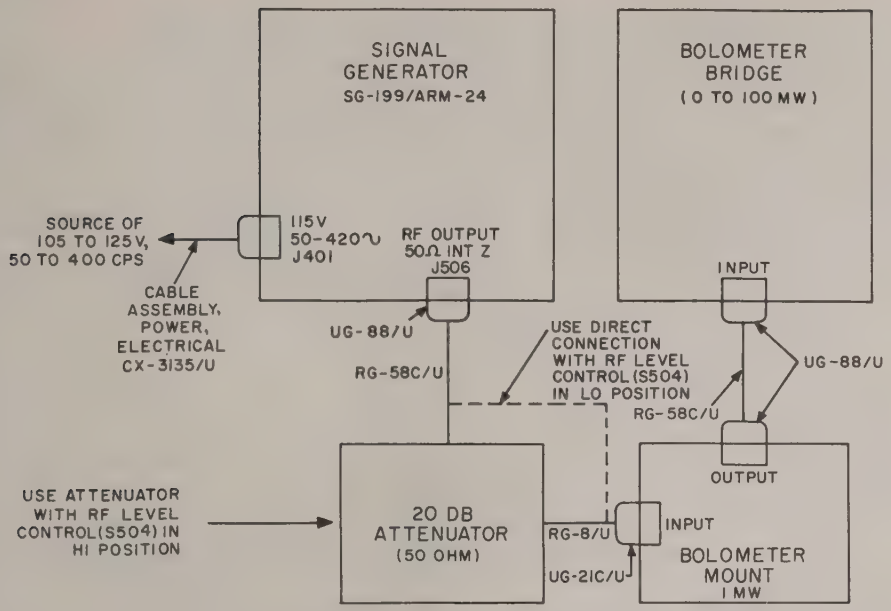


Figure 6-2. Output Amplitude Test

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
1 (cont)	Frequency Converter Control — Setting Function — Mixer Mixing frequency — As required After the appropriate warm-up period, set both the TENS and UNITS controls of the signal generator to a frequency for test purposes. Adjust transfer oscillator frequency to one whose harmonic will beat with the output of the signal generator. Adjust for exact zero beat and then read the transfer oscillator frequency from the combination of the frequency converter and electronic counter. Multiply the transfer oscillator frequency by the number of the harmonic used to get the signal generator frequency. The transfer oscillator frequency is the sum of the mixing frequency switch indication and the reading on the display system of the electronic counter.		
2	Repeat step 1 for the remaining 149 integral mc frequencies, from 400 to 550 mc.	Same as step 1	Same as step 1

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
3	Output Amplitude Test: Connect Signal Generator SG-199/ARM-24 to bolometer bridge, bolometer mount, with 20 db attenuator bypassed as shown in figure 6-2. Set controls as follows: Signal Generator SG-199/ARM-24 Control — Setting DEVIATION RANGE (S102) — Any MODULATION SELECTOR (S101) — OFF Power switch (S401) — HEATER position for at least 1 hour and ON position for at least 10 minutes. Operation selector switch (S501) — XTAL RF LEVEL (S504) — LO ATTENUATOR (Z501) — 100, 000 uv POWER SET (R428) — Adjust for reading at red line on CARRIER MONITOR meter M501. TENS and UNITS controls — 400 mc Bolometer Bridge Control — Setting Bolometer resistance — Resistance of bolometer mount used Power range — As required Temperature coefficient — Coefficient of bolometer mount used Bias current — Current required for bolometer mount used Meter zero set controls — Adjust for zero meter reading with bolometer mount connected to bridge input and with bolometer mount input unloaded. After the appropriate warm-up period, connect the output of the signal generator directly to the bolometer mount input. Be sure that RF LEVEL control S504 is in the LO position. Compute the output amplitude of the signal generator as follows: $E = RW$ Where E is the output amplitude in volts, R is the bolometer mount resistance in ohms, and W is the power reading of the bolometer bridge meter in watts. Compare the computed output amplitude of the signal generator to the reading of the ATTENUATOR dial.	For ATTENUATOR dial setting of 0. 1 v computed output amplitude is within limits of 0. 0895 to 0. 1120 v.	See table 6-4.
4	Repeat step 3 for the remaining 15 integral, 10-mc steps from 400 to 550 mc.	Same as step 3.	Same as step 3.

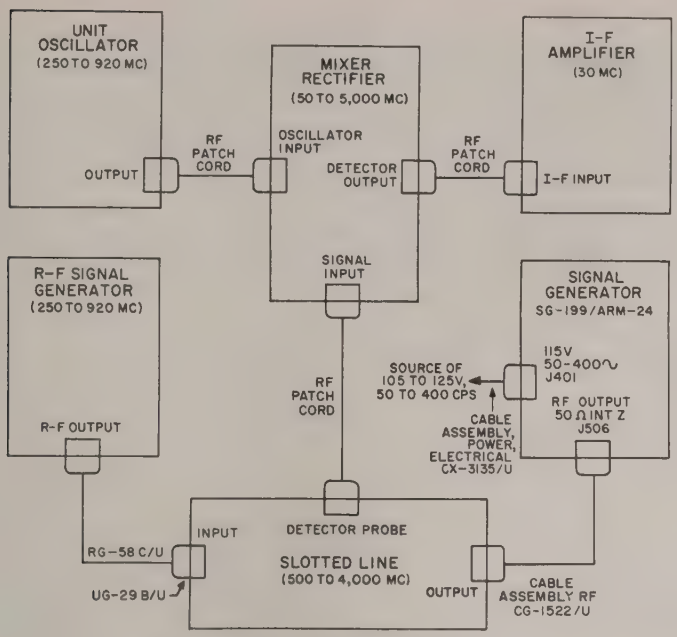


Figure 6-3. Output Impedance Test

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
5	Repeat step 3 but set the ATTENUATOR dial to 0. 05 v and compute output amplitude on volts.	For ATTENUATOR dial setting of 0. 05 v computed output amplitude is within limits of 0. 045 to 0. 050 v.	Same as step 3.
6	Repeat step 5 for the remaining 15 integral, 10-mc steps from 400 to 550 mc.	Same as step 5.	Same as step 3.
7	Repeat step 3 but use 20 db attentuator as shown in figure 6-2 and set RF LEVEL control S504 to HI. Compute output amplitude in volts.	Computed output amplitude is at least 0. 2 v using 20 db attenuator. This corresponds to at least 2. 0 volts output at signal generator.	Same as step 3.
8	Repeat step 7 for the remaining 15 integral, 10-mc steps from 400 to 550 mc.	Same as step 7.	Same as step 3.
9	Output Impedance Test: Connect Signal Generator SG-199/ARM-24 to the following test equipment as shown in figure 6-3: slotted line (500 to 4000 mc), r-f signal generator (250 to 920 mc), unit oscillator (250 to 920 mc), mixer rectifier (50 to 5000 mc), and i-f amplifier (30 mc).	VSWR is ±2 db.	See table 6-4.

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
9 (cont)	Set controls as follows: Signal Generator SG-199/ARM-24 Control — Setting Power Switch (S401) — HEATER RF LEVEL (S504) — LO I-f Amplifier Control — Setting AVC — OFF Attenuator — As required Unit Oscillator Control — Setting Frequency — 400 mc R-f Signal Generator Control — Setting Frequency — 400 mc Slide carriage of slotted line from one end to the other and record the difference between maximum and minimum readings on the i-f amplifier output meter. The difference is the VSWR in db.		
10	Repeat step 9 for the remaining 15 integral, 10-mc steps from 400 to 550 mc by varying the frequency of the unit oscillator accordingly.	Same as step 9.	Same as step 9.

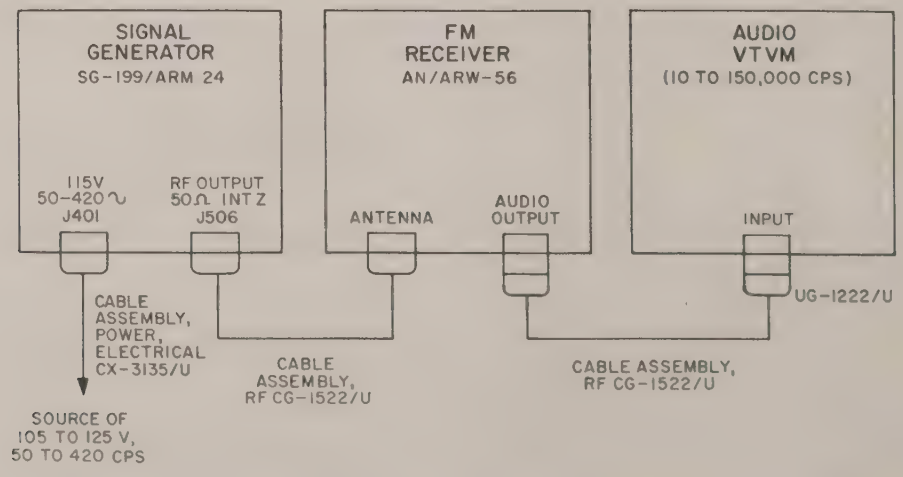


Figure 6-4. Spurious F-M Test

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
11	Spurious f-m test: Connect Signal Generator SG-199/ARM-24 to F-m Receiver AN/ARW-56 and audio vtvm as shown in figure 6-4. Set controls as follows: Signal Generator SG-199/ARM-24 Control — Setting DEVIATION RANGE (S102) — 300 MODULATION SELECTOR (S101) — 400 Power switch (S401) — HEATER position for at least 1 hour and ON position for at least 10 minutes. TENS and UNITS controls — 400 mc Operation selector switch (S501) — XTAL RF LEVEL (S504) — LO DEVIATION LEVEL (R119) — Adjust for 300 kc reading of MODULATION meter M101. F-m Receiver AN/ARW-56 Tune receiver to signal generator output frequency. Audio Vtvm Decibel scale - range as required. After appropriate warm-up period, record reading of audio vtvm in db, then switch MODULATION SELECTOR S101 to OFF and record new reading of audio vtvm. The difference between first and second readings is value of spurious fm in db.	44 db below 300 kc.	See table 6-4.
12	Repeat step 11 for the remaining 15 integral, 10-mc steps from 400 to 500 mc.	Same as step 11.	Same as step 11.
13	Spurious a-m test: Connect Signal Generator SG-199/ARM-24 to the following test equipment and parts as shown in figure 6-5: audio vtvm (910 to 150,000 cps); d-c vtvm; 50 ohm resistor, 1/2 watt, non-inductive; 1000 ohm resistor, 1/2 watt, non-inductive; 100 uuf ceramic capacitor. D-c Vtvm Set to low voltage d-c scale as required. After the appropriate warm-up period, set both the TENS and UNITS controls to 400 mc. The percent spurious am can be caluclated from the following formula: $\frac{A}{B}$ X 141 = percent spurious am	Less than 10 percent spurious am with 300 kc deviation.	See table 6-4.

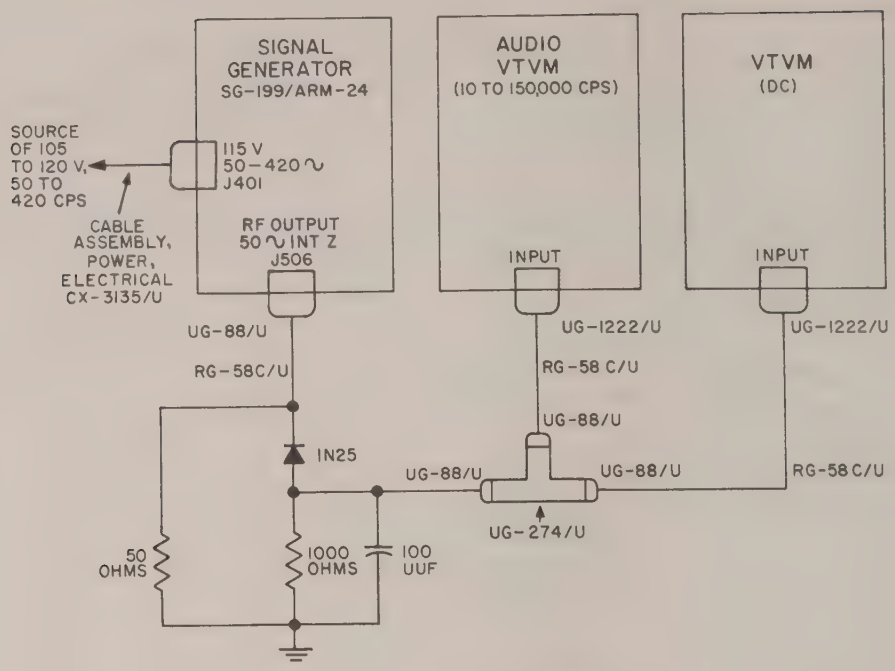


Figure 6-5. Spurious A-M Test

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
13 (cont)	where A = ac reading of audio vtvm and B = dc reading of dc vtvm. Set controls as follows: Signal Generator SG-199/ARM-24 Control — Setting DEVIATION RANGE (S102) — 300 MODULATION SELECTOR (S101) — 400 ∿ Power switch (S401) — HEATER position for at least 1 hour and ON position for at least 10 minutes. Operation selector switch (S401) — XTAL RF LEVEL (S504) — HI DEVIATION LEVEL (R119) — Adjust for 300 kc reading of MODULATION meter M101. Audio Vtvm Set to low voltage a-c scale as required.		

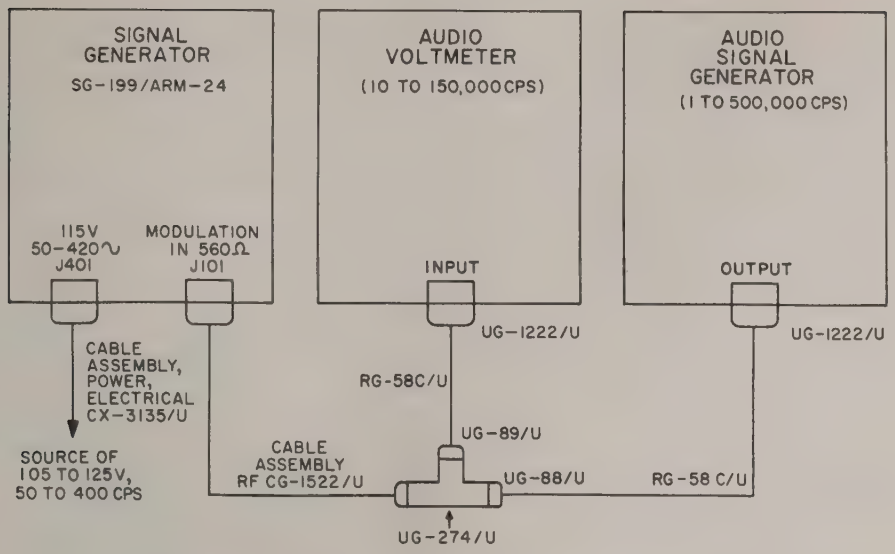


Figure 6-6. External Modulation Voltage Range Test

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
14	External modulation voltage range test: Connect Signal Generator SG-199/ARM-24 to audio voltmeter and audio signal generator as shown in figure 6-6. Set controls as follows: Signal Generator SG-199/ARM-24 Control — Setting DEVIATION RANGE (S102) — 300 MODULATION SELECTOR (S101) — EXT MOD Operation selector switch (S501) — XTAL Power switch (S401) — HEATER position for at least 1 hour, then ON position for at least 10 minutes. DEVIATION LEVEL (R119) — Adjust for 300 kc reading of MODULATION meter M101. Audio Signal Generator Control — Setting Frequency — 300 cps Output level — 0.8 volt	MODULATION meter M101 can be adjusted to 300 kc by means of DEVIATION LEVEL control R119 with given input.	See table 6-6.

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
14 (cont)	Audio Voltmeter Set to low voltage scale and measure output level of audio signal generator.		
15	Repeat step 14 but with test frequencies of 600, 1000, 3000, 6000, 10000, 30000, 60000, and 100000 cps all at 0.8 v.	Same as step 14 for each test frequency.	Same as step 14.
16	Repeat step 14 but with 6.0 v test signal at frequencies of 300, 600, 1000, 3000, 6000, 10000, 30000, 60000, and 100000 cps.	Same as step 14 for each test frequency.	Same as step 14.
17	Internal Modulating Oscillator Frequency Test: Connect signal Generator SG-199/ARM-24 to F-m Receiver AN/ARW-56 and electronic counter (10 cps to 10 mc) as shown in figure 6-7. Set controls as follows: Signal Generator SG-199/ARM-24 Control — Setting DEVIATION RANGE (S102) — 300 MODULATION SELECTOR (S101) — 400 Operation selector switch (S501) — XTAL RF LEVEL (S504) — LO Power switch (S401) — HEATER position for at least 1 hour, then ON position for at least 10 minutes. DEVIATION LEVEL (R119) — Adjust for 300 kc reading of MODULATION meter M101. F-m Receiver AN/ARW-56 Control — Setting Frequency — Frequency of signal generator. R-f gain — As required. Electronic Counter Control — Setting Function selector — Frequency Frequency unit — 10 sec Mixing frequency — 0 Electron-ray "eye" — Just closed	Electronic counter indicates 400 ±8 cps.	See table 6-6.

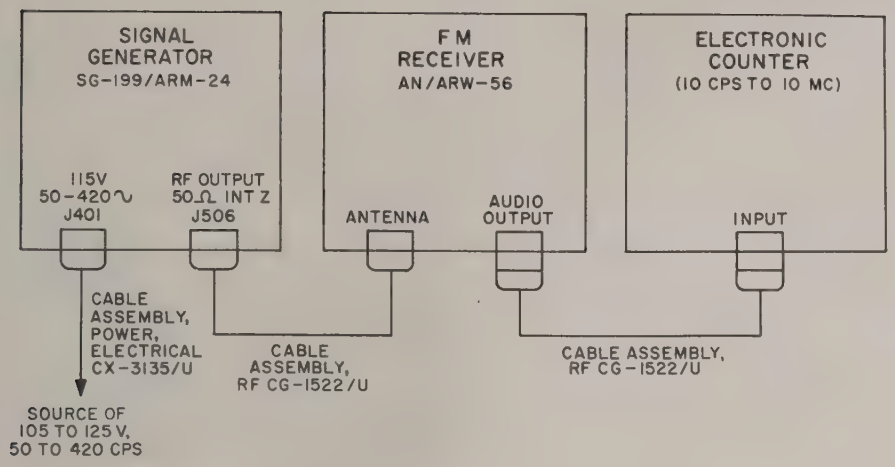


Figure 6-7. Internal Modulating Oscillator Frequency Test

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
18	Repeat step 17 but with MODULATION SELECTOR (S101) set to 1000 .	Electronic counter indicates 1000 ±10 cps.	See table 6-6.
19	Test of frequency stability for line voltage extremes: Connect Signal Generator SG-199/ARM-24 and test equipment as shown in figure 6-1. Set controls as indicated in step 1. Vary line potential from 103.5 to 126.5 volts with Signal Generator SG-199/ARM-24 operating at frequencies of 400, 450, 500, and 550 mc.	Frequency accurate to ±0.002 percent for integral mc points.	See tables 6-4 and 6-5.
20	Test of frequency stability for line frequency extremes: Repeat step 19 with potential constant at line frequencies of 50, 60, 400, and 420 cps.	Same as step 19.	Same as step 19.

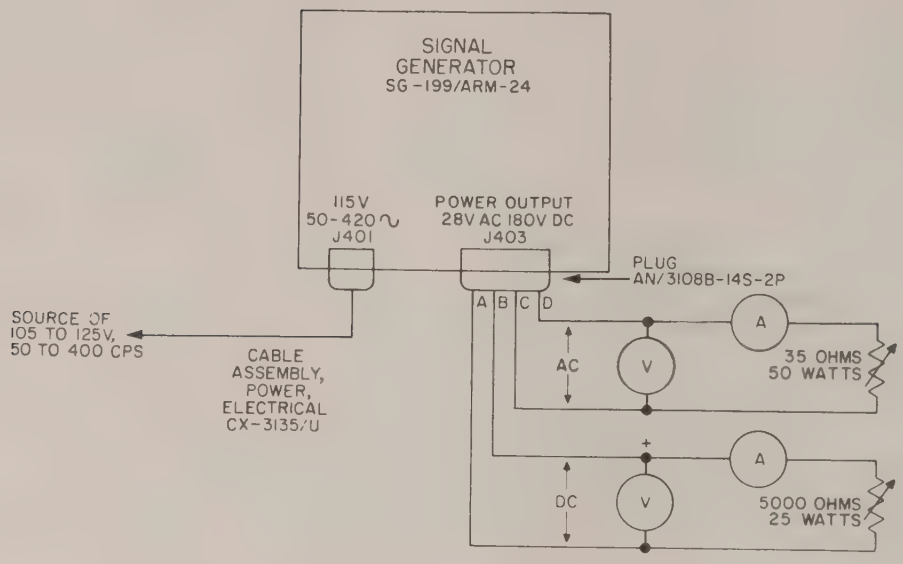


Figure 6-8. Coder Supply Voltage Test

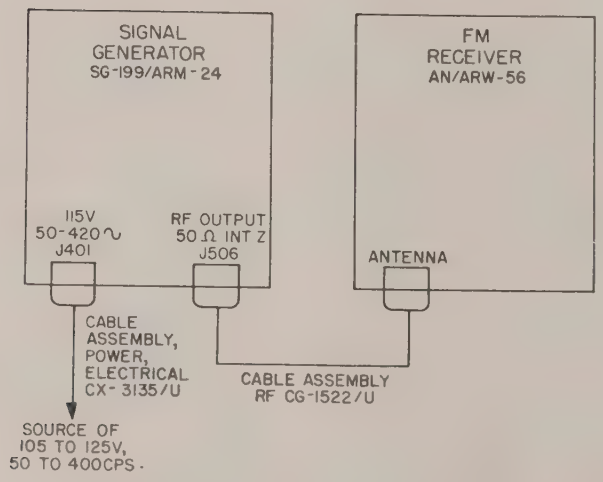


Figure 6-9. Spurious Signals Test

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
21	Coder supply voltage test: Connect Signal Generator SG-199/ARM-24 to source of 117-volt, 60 cps and connect POWER OUTPUT receptacle J403 to loads and a-c and d-c voltmeters and ammeters as indicated in figure 6-8. Measure a-c voltage with load current of 1.1 ampere. Measure d-c voltage with load current of 45 ma.	Approximately 180 volts dc and 28 volts ac.	See tables 6-4 and 6-5.
22	Spurious signals test: Connect Signal Generator SG-199/ARM-24 to F-m Receiver AN/ARW-56 as shown in figure 6-9. Set controls as follows: Signal Generator SG-199/ARM-24 Control — Setting DEVIATION RANGE (S102) — 300 MODULATION SELECTOR (S101) — 400 Operation selector switch (S501) — VFO Power Switch (S401) — HEATER position for at least 1 hour, then ON position for at least 10 minutes. RF LEVEL (S504) — LO DEVIATION LEVEL (R119) — Adjust for 300 kc reading of MODULATION meter M101. TENS and UNITS controls — 400 mc ATTENUATOR (Z501) — Adjust for reading of 40 db above minimum output on ATTENUATOR dial. F-m Receiver AN/ARW-56 Control — Setting Frequency — Tune 400 to 550 mc band and observe S-meter. R-f gain — As required If S-meter reading on f-m receiver is observed for any frequencies other than that of the signal generator, record the S-meter reading for the	Spurious response is at least 40 db below original reading of ATTENUATOR dial.	See table 6-4.

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
22 (cont)	spurious response and proceed as follows: Adjust frequency of signal generator (TENS and UNITS controls) to frequency of spurious response. Adjust ATTENUATOR (Z501) on signal generator until S-meter reading of f-m receiver is the same as that recorded for spurious response. Subtract the second ATTENUATOR dial reading from the first.		
23	Repeat step 22 for the 150 remaining integral mc frequencies of signal generator.	Same as step 22.	Same as step 22.
24	Deviation accuracy test: Connect Signal Generator SG-199/ARM-24 to the following test equipment as shown in figure 6-10: audio signal generator (1 cps to 500 kc), audio vtvm (10 to 150000 cps), transfer oscillator (100 to 5000 mc), and electronic counter (10 cps to 10 mc) with frequency converter (100 to 200 mc). Set controls as follows: Signal Generator SG-199/ARM-24 Control — Setting DEVIATION RANGE (S102) — 300 MODULATION SELECTOR (S101) — COMPRESSOR Operation selector switch (S501) — XTAL RF LEVEL (S504) — HI Power switch (S401) — HEATER position for at least 1 hour, then ON position for at least 10 minutes. DEVIATION LEVEL (R119) — Adjust for 300 kc reading of MODULATION meter M101. TENS and UNITS controls — Any Audio Signal Generator Control — Setting Frequency — 300 cps Output level — 6.0 volts Audio Vtvm Set to zero to low voltage scale and measure output level of audio generator.	Deviation limits within 270 to 330 kc.	See table 6-4.

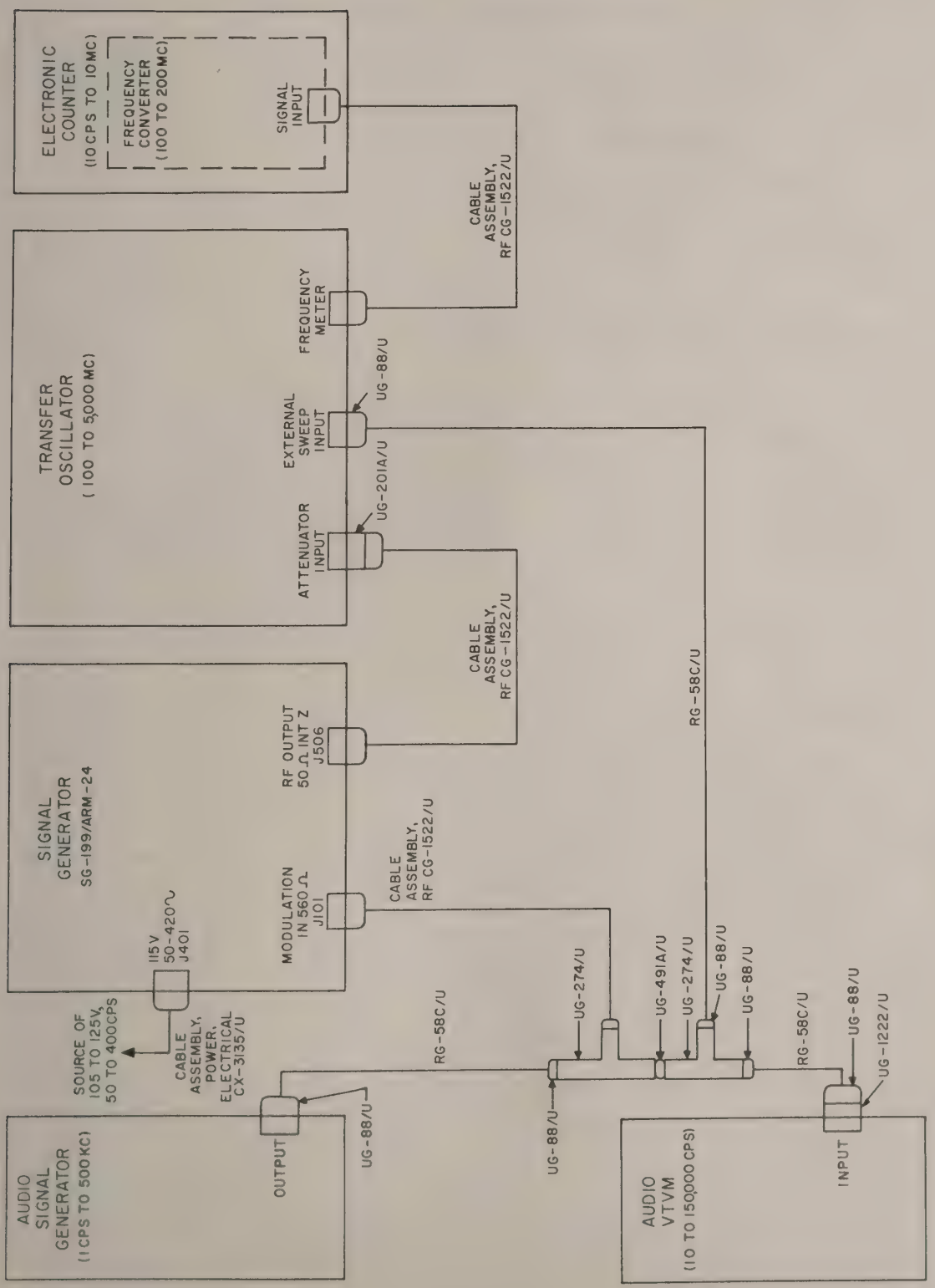


Figure 6-10. Deviation Accuracy Test

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
24 (cont)	Transfer Oscillator Control — Setting Attenuator — Approximately 40 db Power switch — On External-Internal sweep switch — External (Attenuator output to mixer input B and mixer input A to oscillator output) Electronic Counter Control — Setting Function — Frequency Frequency unit — 10 sec Display time — As required 1000 kc frequency standard — Internal Frequency Converter Control — Setting Function — Mixer Mixing frequency — As required Determine limits of frequency deviation as follows: Adjust transfer oscillator frequency to one whose harmonics will beat with the output of the signal generator. Adjust transfer oscillator for internal oscilloscope zero-beat readings at each of the two limits of frequency deviation. Read the transfer oscillator frequency for each of the two zero-beats from the combination of the frequency converter and electronic counter. Multiply the transfer oscillator frequency by the number of the harmonic used to get the signal generator frequency. The transfer oscillator frequency is the sum of the mixing frequency switch indication and the reading on the display system of the electronic counter.		
25	Repeat step 24 using audio generator frequencies of 600, 1000, 3000, 6000, 10000, 30000, 60000, and 100000 cps.	Same as step 24 for each test frequency.	Same as step 24.
26	Repeat step 24 with DEVIATION LEVEL control (R119) adjusted for deviation of 150 kc using audio generator frequencies of 600, 1000, 3000, 6000, 10000, 30000, 60000, and 100000 cps.	Deviation limit within 135 to 165 kc for each test frequency.	Same as step 24.

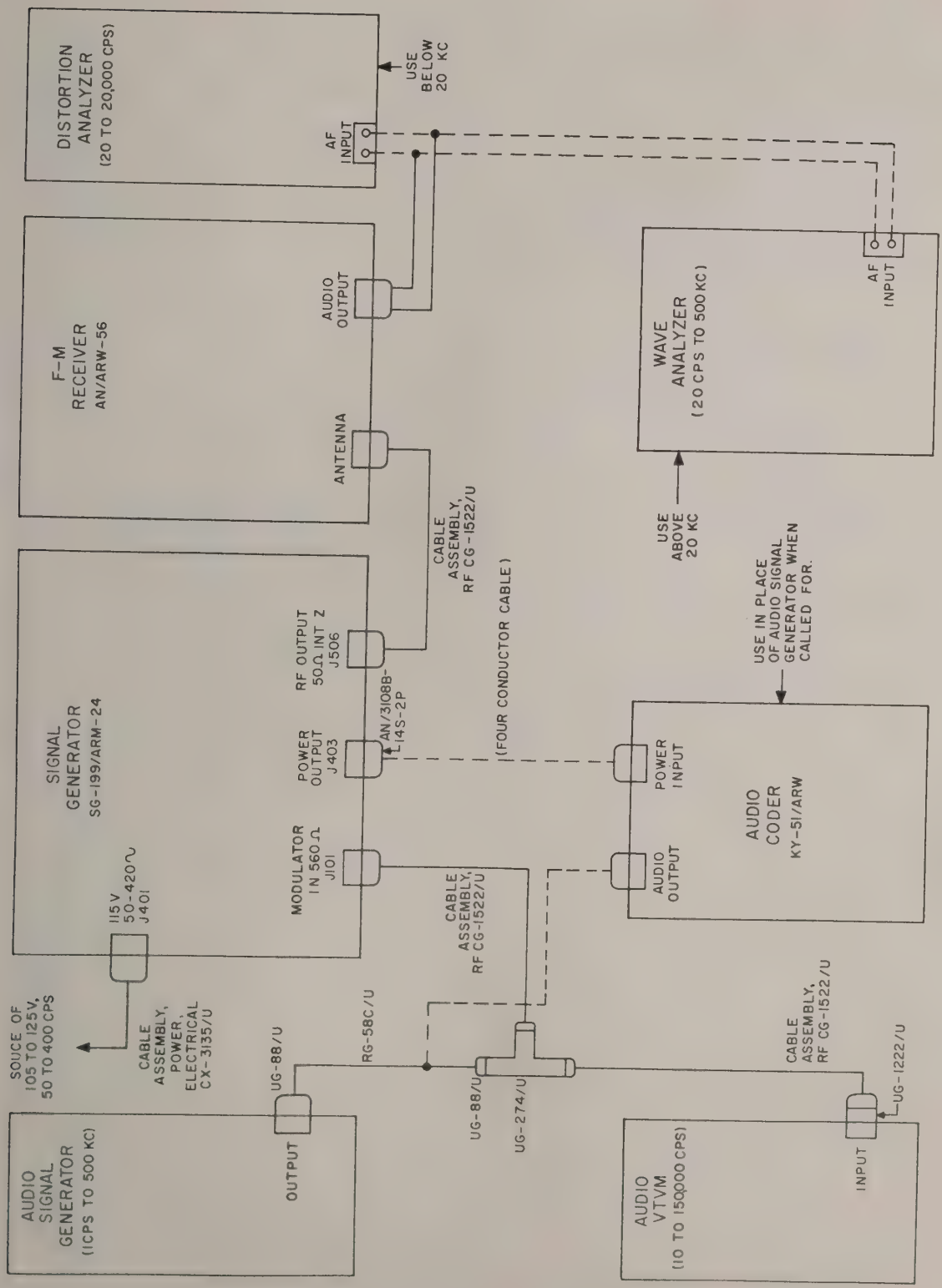


Figure 6-11. Deviation Amplitude Distortion Test

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
27	Deviation amplitude distortion test: Connect Signal Generator SG-199/ARM-24 to the following test instruments as shown in figure 6-11. F-m Receiver AN/ARW-56, audio signal generator (1 cps to 500 kc), audio vtvm (10 cps to 150 kc), and distortion analyzer (20 to 20000 cps). Set controls as follows: Audio Signal Generator Control — Setting Frequency — 300 cps Output level — 6.0 volts Audio Vtvm Set to low-voltage scale Signal Generator SG-199/ARM-24 Control — Setting DEVIATION RANGE (S102) — 300 MODULATION SELECTOR (S101) — EXT MOD Operation selector (S501) — XTAL TENS and UNITS controls — 500 mc Power switch (S401) — HEATER position for at least 1 hour, then ON position for at least 10 minutes. DEVIATION LEVEL (R119) — Adjust for reading of 300 kc on MODULATION meter M101. RF LEVEL (S504) — LO ATTENUATOR (Z501) — 500 v F-m Receiver AN/ARW-56 Control — Setting Frequency — 500 mc R-f gain — As required	Less than 1 percent distortion.	See table 6-6.

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
27 (cont)	Distortion Analyzer Control — Setting Range control — 300 cps Rms volts-db switch — 100 percent Input control — Adjust for full-scale reading of meter. Amplifier switch — Distortion Frequency control — Approximately 300 cps, tune for minimum meter reading in conjunction with balance control. Balance control — Tune for minimum meter reading in conjunction with balance control. Read distortion in percent on distorition analyzer meter after frequency and balance controls on distortion analyzer are adjusted for minimum meter reading.		
28	Repeat step 27 but with test frequencies of 600, 1000, 3000, 6000, and 10000 cps. Adjust audio signal generator and distortion analyzer frequency controls accordingly, for each test.	Same as step 27.	Same as step 27.
29	Repeat step 27 using wave analyzer for frequencies of 30000, 60000, and 100000 cps in place of the distortion analyzer and set controls of the wave analyzer as follows: Control — Setting Power switch — ON position for at least 20 minutes Db meter switch — Receive I-f gain control — Adjust for zero meter reading Injector switch — Receive Tuning control — Tune to test frequency Input attenuator range switch — As required Input attenuator level control — 8 to 12 db Record combined readings of input attenuator range switch, input attenuator level control, and db meter. Tune in the successive harmonics with the input level constant and set the attenuator range switch for a db meter reading between -10 and +2 db and record readings of distortion analyzer controls for each harmonic. The total distortion is evaluated from the db readings of the fundamental and harmonics from: $\text{Percent total distortion} = 100 \quad 2^2 + 3^2 + \cdots + \frac{2}{n}$	Less than one percent total distortion.	Same as step 27.

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
29 (cont)	where: $\gamma_2, \gamma_3, \gamma_n$ = voltage ratio equivalent (to power ratio) of the second, third, and nth harmonic, respectively, in db. $= \frac{B}{A} < 1$ where: A = Meter reading of the fundamental in db B = Meter reading of the second, third, ..., nth harmonic in db NOTE All values of γ are fractions because $B < A$; never $B \geq A$. Refer to standard db-to-voltage conversion table for arriving at value of γ_n. Substitute the table derived voltage for all harmonics (γ_2, γ_3, etc.) in the percent total distortion equation and compute value.		
30	Compressor deviation amplitude distortion test: Repeat steps 27, 28, and 29, using KY-51/ARW Audio Coder in place of the audio signal generator for frequencies of 7000, 10000, 30000, 60000, and 80000 cps. Central settings remain the same except set MODULATION SELECTOR (S101) to COMPRESSOR on Signal Generator SG-199/ARM-24. Use distortion analyzer and procedure in test 27 for frequencies below 20000 cps and use wave analyzer and procedure in step 29 for frequencies above 20000 cps.		
31	Deviation Phase Distortion Test: Connect Signal Generator SG-199/ARM-24 to the following test equipment as shown in figure 6-12: audio signal generator (10 to 150000 cps), F-m Receiver AN/ARW-56, oscilloscope (dc to 30 mc), and audio vtvm (10 to 150000 cps). Set controls as follows: Signal Generator SG-199/ARM-24 Control — Setting DEVIATION RANGE (S102) — 300 MODULATION SELECTOR (S101) — EXT MOD		

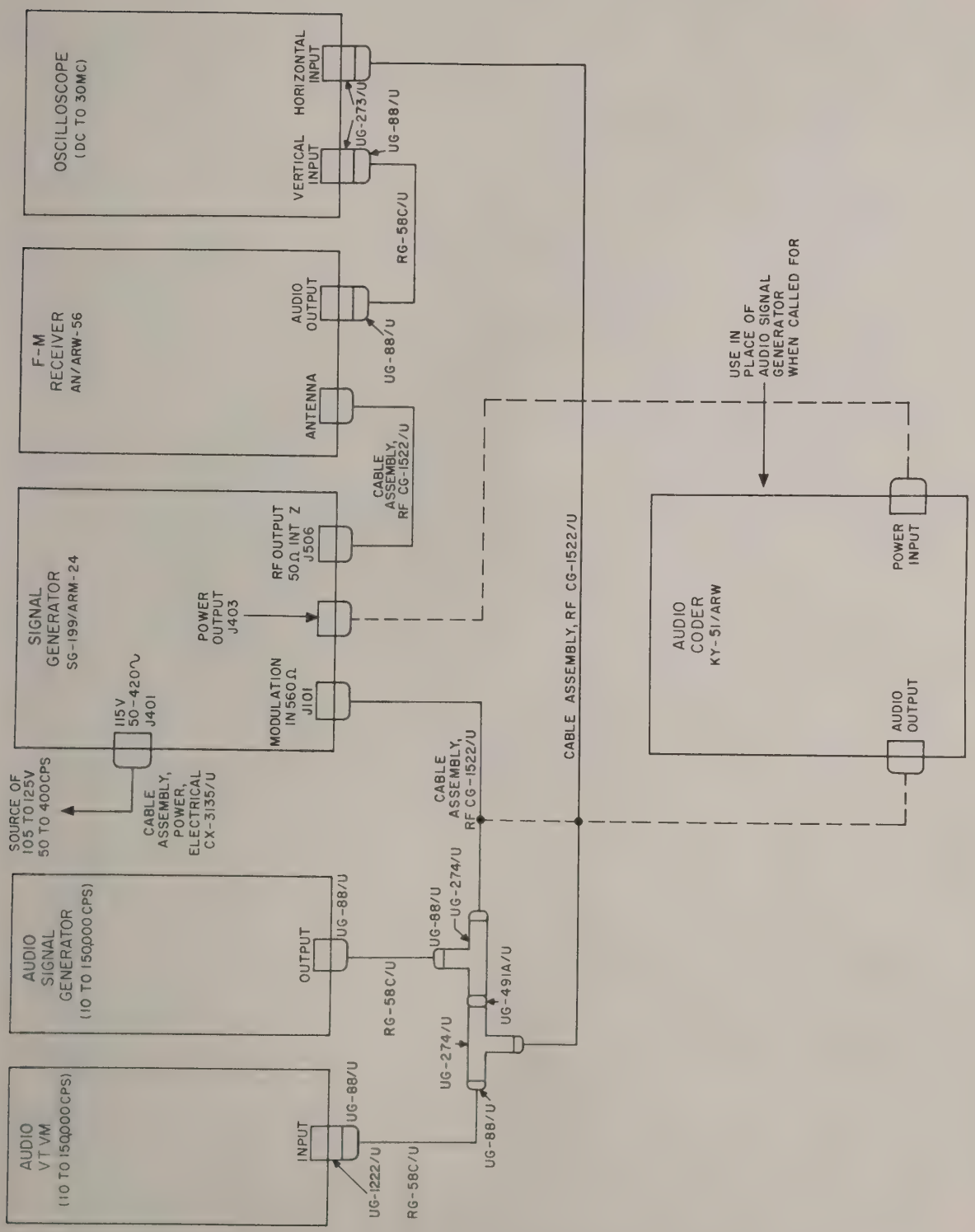


Figure 6-12. Deviation Phase Distortion and Amplitude Variation Test

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

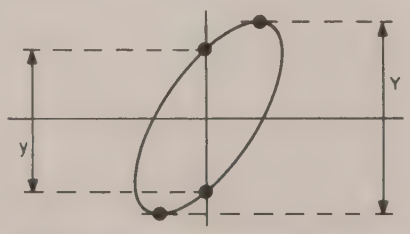
Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
31	Signal Generator SG-199/ARM-24 (cont) Control — Setting Operation selector switch (S501) — XTAL Power switch (S401) — HEATER position for at least 1 hour, then ON position for at least 10 minutes. DEVIATION LEVEL (R119) — Adjust for 300 kc reading of MODULATION meter M101. TENS and UNITS controls — Any RF LEVEL (S504) — HI ATTENUATOR (Z501) — As required Audio Vtvm Set to low voltage scale. Audio Signal Generator Control — Setting Frequency — 300 cps Output level — 6.0 volts F-m Receiver AN/ARW-56 Control — Setting Frequency — Same as signal generator SG-199/ARM-24 R-f gain — As required Oscilloscope Control — Setting Sweep selector — External Horizontal amplifier gain — Same as vertical Vertical amplifier gain — Same as horizontal Determine the phase angle from the oscilloscope display as follows:  		

TABLE 6-1

SYSTEM MINIMUM PERFORMANCE STANDARDS (cont)

Step	Control Settings and Instructions	Normal Indication	If Indication is Abnormal
31 (cont)	Where Y = Peak-to-peak displacement of display on y-coordinates y = Maximum separation of trace on y-coordinates Compute phase angle ϕ from $\phi = \text{SIN}^{-1}\frac{y}{Y}$ or phase angle in degrees is equal to the angle whose size is y/Y.		
32	Repeat step 31 with test frequencies of 600, 1000, 3000, 6000, 10000, 30000, 60000, and 100000 cps. Adjust audio signal generator frequency control accordingly, for each test.	Same as step 31.	Same as step 31.
33	Repeat steps 31 and 32 with audio signal generator output level of 0.8 volt.	Same as step 31.	Same as step 31.
34	Compressor phase distortion test: Repeat step 31 for frequencies of 7000, 10000, 30000, 60000, and 80000 cps with the following exceptions: Place MODULATION SELECTOR (S101) on Signal Generator SG-199/ARM-24 in COMPRESSOR position. Remove audio vtvm and connection to horizontal input of oscilloscope. Set oscilloscope to internal sweep at random low sweep frequency where peak amplitude and separation of waveshape can be observed.		
35	Compressor amplitude variation test: Repeat step 31 using Audio Coder KY-51/ARW in place of audio signal generator and with MODULATION SELECTOR (S101) on Signal Generator SG-199/ARM-24 in COMPRESSOR position. Record variation in amplitude for frequencies of 7000, 10000, 20000, 30000, 60000, and 80000 cps.	Total amplitude variation of 10 percent, maximum.	Same as step 31.

TABLE 6-2

POWER SUPPLY MINIMUM PERFORMANCE STANDARDS

Step	Test Point	Test Equipment	Procedure	Normal Indication	Adjustment
1	None	None	Adjust primary power to 117 volts, 60 cps. Observe operation of blower fan assembly B401.	Blower fan operates	None
2	and gnd	Multimeter	Adjust primary power to 117 volts, 60 cps. Measure d-c voltage between test points.	-10 volts dc	R419

TABLE 6-2

POWER SUPPLY MINIMUM PERFORMANCE STANDARDS (cont)

Step	Test Point	Test Equipment	Procedure	Normal Indication	Adjustment
3	(4) and gnd	Multimeter	Vary primary power between 103 and 127 volts at 60 cps. Measure d-c voltage between test points.	-10 ±0. 1 volts dc	None
4	(C11) and gnd	A-c vtvm	Vary primary power between 50 and 400 cps at 115 volts. Measure a-c ripple between test points.	8 mv rms, max	None
5	(C12) and gnd	Multimeter	Adjust primary power to 117 volts, 60 cps. Measure d-c voltage between test points.	+240 volts dc	R422
6	(C12) and gnd	Multimeter	Vary primary power between 103 and 127 volts at 60 cps. Measure d-c voltage between test points.	+240 ±1 volt dc	None
7	(C12) and gnd	A-c vtvm	Vary primary power between 50 and 400 cps at 115 volts. Measure a-c ripple between test points.	8 mv rms, max	None
8	(9) and gnd	Multimeter	Adjust primary power to 117 volts, 60 cps. Measure d-c voltage between test points.	+180 volts dc, approx	None
9	None	Multimeter	Insert adapter in socket of OA2WA (V413) to monitor current from 0 to 10 ma. Adjust primary power to 100 volts, 60 cps. CAUTION Be sure that potentiometer R408 is set to 25k (max resistance) before applying power. This prevents damage to rectifier V406 due to overload.	5 ma dc	R408
10	(C13) and gnd	D-c vtvm	Vary primary power between 103 and 125 volts, 60 cps. Measure d-c voltage between test points.	-150 ±0. 5 volts dc	None

TABLE 6-2

POWER SUPPLY MINIMUM PERFORMANCE STANDARDS (cont)

Step	Test Point	Test Equipment	Procedure	Normal Indication	Adjustment
11	(C) and (D)	A-c vtvm	Adjust primary power to 117 volts, 60 cps. Measure a-c voltage between test points.	6.3 ±0.32 volts a-c	None
12	(E) and gnd	A-c vtvm	Adjust primary power to 117 volts, 60 cps. Measure a-c voltage between test points.	6.3 ±0.32 volts a-c	None
13	(J) and gnd	A-c vtvm	Adjust primary power to 117 volts, 60 cps. Measure a-c voltage between test points.	6.3 ±0.32 volts a-c	None
14	(Z) and gnd	A-c vtvm	Vary primary power between 103 and 125 volts, 60 cps. Measure a-c voltage between test points.	6.3 ±0.2 volts a-c	None

TABLE 6-3

AUDIO UNIT MINIMUM PERFORMANCE STANDARDS

Step	Test Point	Test Equipment	Procedure	Normal Indication	Adjustment
1	(3) and gnd	A-c vtvm	Set MODULATION SELECTOR switch S101 to 400∿. Set DEVIATION RANGE switch S102 to 300. Rotate DEVIATION LEVEL control fully clockwise. Measre a-c voltage between test points.	0.7 volt a-c	R103
2	(3) and gnd	A-c vtvm	Set MODULATION SELECTOR switch S101 to 400∿. Set DEVIATION RANGE switch S102 to 300. Adjust DEVIATION LEVEL control R119 until 0.5 volt ac is measured between test points. Observe MODULATION meter M101.	MODULATION meter M101 reads 300 kc.	None
3	(3) and gnd	Electronic counter and a-c vtvm	Set MODULATION SELECTOR switch S101 to 400∿. Adjust DEVIATION LEVEL control R119 for 0.5 volt ac at test points using a-c vtvm. Measure frequency between test points using electronic counter.	400 ±8 cps	None

TABLE 6-3

AUDIO UNIT MINIMUM PERFORMANCE STANDARDS (cont)

Step	Test Point	Test Equipment	Procedure	Normal Indication	Adjustment
4	3 and gnd	Electronic counter and a-c vtvm	Set MODULATION SELECTOR switch S101 to 1000∿. Adjust DEVIATION LEVEL control R119 for 0.5 volt ac at test points using a-c vtvm. Measure frequency between test points using electronic counter.	1000 ±20 cps	None
5	3 and gnd	A-c vtvm and audio generator	Set MODULATION SELECTOR switch S101 to EXT MOD. Set DEVIATION RANGE switch S102 to 300. Rotate DEVIATION LEVEL control R119 fully clockwise. Apply 0.8 volt, 300 cps, to 560Ω MODULATION IN jack J101. Measure a-c voltage between test points.	0.7 volt a-c min	None
6	3 and gnd	A-c vtvm and audio generator	Set MODULATION SELECTOR switch S101 to EXT MOD. Set DEVIATION RANGE switch S102 to 300. Apply 0.8 volt, 300 cps, to 560Ω MODULATION IN jack S101. Adjust DEVIATION LEVEL control R119 for 0.5 volt ac between test points. Observe MODULATION meter M101.	MODULATION meter M101 reads 300 kc.	None
7	3 and gnd	A-c vtvm and audio generator	Set MODULATION SELECTOR switch S101 to EXT MOD. Set DEVIATION RANGE switch S102 to 300. Apply alternately, 0.8 volt, 300 cps, 1000 cps, 5000 cps, 10000 cps, 50000 cps, and 100000 cps, to 560Ω MODULATION IN jack J101. Adjust DEVIATION LEVEL control for 300 kc reading of MODULATION meter M101 and measure a-c voltage between test points, for each input frequency.	0.5 volt a-c	None
8	3 and gnd	A-c vtvm, audio generator, and distortion analyzer	Set MODULATION SELECTOR switch S101 to EXT MOD. Set DEVIATION RANGE switch S102 to 300. Apply 6 volts, 300 cps, to 560Ω MODULATION IN jack J101. Adjust DEVIATION LEVEL control R119 for 300 kc reading on MODULATION meter M101. Measure distortion between test points.	Less than 1 percent distortion	None

TABLE 6-3

AUDIO UNIT MINIMUM PERFORMANCE STANDARDS (cont)

Step	Test Point	Test Equipment	Procedure	Normal Indication	Adjustment
9	3 and gnd	A-c vtvm, audio generator, and distortion analyzer	Same as step 7 except apply alternately, 6 volts, 1000 cps, 10000 cps, and 100000 cps to 560 Ω MODULATION IN jack J101. Measure distortion in each case between test points. NOTE Use distortion analyzer of the proper frequency range. See table 2-1.	Less than 1 percent distortion	None
10	3 and gnd	A-c vtvm and audio generator	Set MODULATION SELECTOR switch S101 to COMPRESSOR. Apply 1 volt, 10000 cps to 560 Ω MODULATION IN jack J101. Rotate DEVIATION LEVEL control R119 fully clockwise. Measure a-c voltage between test points.	0.7 to 0.8 volt ac	R145
11	3 and gnd	Oscilloscope and audio generator	Set MODULATION SELECTOR switch S101 to COMPRESSOR. Apply alternately 0.8 volt, 10000 cps and 6 volts, 10000 cps to 560 Ω MODULATION IN jack J101. Measure peak-to-peak output between test points, for each input frequency, using oscilloscope.	Peak-to-peak output does not vary more than 10 percent at same setting of DEVIATION LEVEL control R119.	None
12	3 and gnd	A-c vtvm, and audio generator	Set MODULATION SELECTOR switch S101 to COMPRESSOR. Apply alternately, 6 volts, 8000 cps, 20000 cps, and 80000 cps to 560 Ω MODULATION IN jack J101. Measure output between test points, for each input frequency.	Output voltage varies no more than 2 percent at same setting of DEVIATION LEVEL control R119 between any pair of input frequencies.	None
13	3 and gnd	A-c vtvm, audio generator, and distortion analyzer	Set MODULATION SELECTOR switch S101 to COMPRESSOR Apply alternately, 6 volts, 8000 cps, 20000 cps, and 80000 cps to 560 Ω MODULATION IN jack J101. Measure distortion between test points, for each input frequency.	Not more than 2 percent distortion in each case.	None

6-5. TROUBLE ANALYSIS.

6-6. Trouble analysis for the signal generator is covered in tables 6-4 through 6-8. To facilitate trouble isolation, refer to block diagrams and simplified schematic diagrams, figures 4-1 through 4-7, and schematic diagrams, figures 7-1 through 7-4.

6-7. Table 6-4, System Trouble Analysis Chart, facilitates localization of malfunctions to one or more of the four major units of the signal generator, on observation of front panel meter indications, operating controls, and r-f output in normal operation. Tables 6-5 through 6-8 isolate troubles to stages, subassemblies, and parts in the power supplies, audio unit, f-m unit, and r-f unit, respectively.

6-8. REMOVAL.

6-9. Removal procedures for the various assemblies of the signal generator are obvious. See figures 6-13 through 6-38 for parts locations.

6-10. VOLTAGE AND RESISTANCE MEASUREMENTS.

6-11. Voltage and resistance data taken at significant points in the signal generator are listed in tables 6-9 and 6-10, respectively. The measurements are made with the test equipment listed in Section II.

6-12. CABLING INFORMATION.

6-13. Cabling information is covered in Section III. Cables supplied with the signal generator are listed in Section I.

6-14. REFERENCE SYMBOLS.

6-15. Reference symbols used for the assemblies of the signal generator are as follows:

a. Audio unit - 101 through 199
b. F-m unit - 201 through 299
c. Power supply unit - 401 through 499
d. R-f unit - 501 through 599 and 601 through 699

TABLE 6-4

SYSTEM TROUBLE ANALYSIS CHART

Step	Symptom of Trouble	Probable Cause	Remedy
1	Signal generator output amplitude Operation selector switch S501: Position — Observation XTAL — no output VFO — no output XTAL+VFO — will not calibrate "Eye" tube V516 — does not "wink" MODULATION deviation meter M101 — no reading CARRIER MONITOR meter M501 — no reading	Fuses F403, F404, F405, F406 or power supplies	Replace fuses or see table 6-5.
2	Operation selector switch S501: Position — Observation XTAL — no output VFO — no output XTAL+VFO — will not calibrate "Eye" tube V516 — "eye winks" MODULATION deviation meter M101 — no reading CARRIER MONITOR meter M501 — no reading	Power supplies	See table 6-5.

TABLE 6-4

SYSTEM TROUBLE ANALYSIS CHART (cont)

Step	Symptom of Trouble	Probable Cause	Remedy
	Signal generator output amplitude (cont)		
3	Operation selector switch S501: Position — Observation XTAL — no output VFO — no output XTAL+VFO — will not calibrate "Eye" tube V516 — does not "wink" MODULATION deviation meter M101 — normal reading CARRIER MONITOR meter M501 — normal reading	Power supplies of f-m unit	See table 6-5 or table 6-7.
4	Operation selector switch S501: Position — Observation XTAL — no output VFO — output normal	Power supplies F-m unit Tens crystal oscillator V510 Units crystal oscillator V511 Broken dial cable or mechanical linkage (tuning)	See table 6-5. See table 6-7. See table 6-8. See table 6-8. Replace defective parts.
5	Operation selector switch S501: Position — Observation XTAL — output normal VFO — no output XTAL+VFO — will not calibrate	Power supplies F-m unit Tens crystal oscillator V510 Interpolation Oscillator V512 Mechanical linkage (tuning)	See table 6-5. See table 6-7. See table 6-8. See table 6-8. Replace defective parts.
6	Operation selector switch S501: Position — Observation XTAL — output normal VFO — no output XTAL+VFO — calibrates normally	Operation selector switch S501 or associated circuitry	See table 6-6.
7	Not enough r-f output amplitude	Final r-f amplifier V509 detuned or parasitic oscillations in r-f amplifiers V507, V508, V509	See table 6-8.
8	Not enough r-f output and frequency incorrect	Power supplies Final r-f amplifier V509 detuned or parasitic oscillations in r-f amplifiers V507, V08, V509	See table 6-5. See table 6-8.
9	Too much r-f output	Parasitic oscillations in r-f amplifiers V507, V508, V509 Calibration error in voltmeter circuit V515 R-f load from piston attenuator Z501 disconnected (via RF LEVEL switch S504) Power supply output voltage high	See table 6-8. See table 6-8. See table 6-8. See table 6-5.

TABLE 6-4

SYSTEM TROUBLE ANALYSIS CHART (cont)

Step	Symptom of Trouble	Probable Cause	Remedy
	Signal generator output amplitude (cont)		
10	R-f output impedance high or low Signal generator output frequency	RF LEVEL switch S504 or piston attenuator Z501	See table 6-8.
11	All frequencies differ by different factor.	Crystal oven overheats.	See table 6-8.
12	All frequencies differ by common factor.	F-m unit Mechanical linkage (tuning)	See table 6-7. Replace defective parts.
13	Individual frequencies incorrect	Individual crystal failure, broken insulation or components in crystal circuits	See table 6-8.
14	Two adjacent frequency channels off Signal generator modulated output	Common choke for two crystals	See table 6-8.
15	MODULATION deviation meter M101 no reading	Power supplies Audio unit (meter M101)	See table 6-5. See table 6-6.
16	MODULATION deviation meter M101 reading high and uncontrollable	Vtvm tube V112	See table 6-6.
17	MODULATION deviation meter M101 reading low and uncontrollable a. internally modulated b. Internally and externally modulated (without compressor) c. externally modulated via compressor	 Audio oscillator V101 Amplifier V104B or vtvm tube V112 Compressor circuit V102, V103, V104, V105, V106, V107A, V108 or MODULATION SELECTOR switch S101	 See table 6-6. See table 6-6. See table 6-6.
18	MODULATION deviation meter M101 reads normally but no r-f deviation in output	F-m unit (reactance tube V201)	See table 6-7.
19	MODULATION deviation meter M101 reads normally but modulation distorted	F-m unit (reactance tube V201 or bias thereon)	See table 6-7.
20	MODULATION deviation meter M101 reads normally but modulation is high or low	Calibration of meter circuit (vtvm tube V112)	See table 6-6.
21	A-m distortion in modulated output	Audio unit F-m unit	See table 6-6. See table 6-7.
22	Phase distortion in modulated output	Audio unit	See table 6-6.
23	Spurious or incidental fm	R-f unit (mixer V502)	See table 6-8.
24	Spurious or incidental am	R-f unit (amplifiers V508, V509)	See table 6-8.

TABLE 6-5

POWER SUPPLIES TROUBLE ANALYSIS CHART

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
1	8	Multimeter on 250-volt a-c scale	Connect signal generator to suitable source of power and set power switch S401 in HEATER position; other controls any position. Measure voltage between test points.	a. 115 volts a-c b. No voltage	a. Proceed to step 2. b. Check power cable CX-3135/U. Replace defective part and proceed to step 2.
2	V	Same as step 1	Same as step 1	a. 115 volts a-c b. No voltage	a. Proceed to step 3. b. Check L404, L405, F401, F402, S503, J405, P510, J402, and P402. Replace defective parts. NOTE Switch S503 is temperature sensitive. Proceed to step 3.
3	None	None	Same as step 1	a. Heater resistors R401, R402, R403, R424, R425, and R426 become hot. b. Some or all resistors do not heat.	a. Proceed to step 4. b. Check for open resistors. Replace defective parts and proceed to step 4.
4	P	Same as step 1	Same as step 1	a. 115 volts a-c b. No voltage	a. Proceed to step 5. b. Repeat steps 1 and 2.
5	C6	Same as step 1	Same as step 1	a. 115 volts a-c b. No voltage	a. Proceed to step 6. b. Check T405, replace defective part and proceed to step 6.
6	U	Same as step 1	Same as step 1 but with power switch S401 in ON position. Measure voltage between test points, observe operation of blower B401.	a. 115 volts a-c and blower operates. b. 115 volts a-c and blower does not operate. c. No voltage, and blower does not operate.	a. Proceed to step 7. b. Check for open blower motor, C412, and S502. Replace defective part and proceed to step 7. NOTE Switch S502 is temperature sensitive. c. Check F403, F404, and S401. Replace defective parts and repeat step 6.

TABLE 6-5

POWER SUPPLIES TROUBLE ANALYSIS CHART (cont)

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
7	Q	Same as step 1	Same as step 6	a. 115 volts a-c b. No voltage	a. Proceed to step 8. b. Check F405, F406, S401, J406 and P406. Replace defective parts and proceed to step 8.
8	R	Same as step 1	Same as step 6	a. 115 volts a-c b. No voltage	a. Proceed to step 9. b. Repeat procedure step 7, b.
9	S	Same as step 1	Same as step 6	a. 115 volts a-c b. No voltage	a. Proceed to step 10. b. Check J406 and P406 and repeat procedure step 6, c.
10	T	Same as step 1	Same as step 6	a. 115 volts a-c b. No voltage	a. Proceed to step 11. b. Check J406 and P406 and repeat procedure step 6, c.
11	10	Same as step 1	Same as step 6	a. 28 volts a-c, and power-on lamp I401 lights. b. 28 volts a-c, and power-on lamp I401 does not light. c. No voltage	a. Proceed to step 12. b. Check I401 and R427. Replace defective parts and proceed to step 12. c. Check T404, J406 and P406. Replace defective parts and proceed to step 12.
12	9 and gnd	Multimeter 250-volt d-c scale	Same as step 6	a. +180 volts d-c b. No voltage	a. Proceed to step 15. b. Trouble in +180-volt d-c supply, proceed to step 13.
13	C5	Multimeter 1000-volt a-c scale	Same as step 6 and observe filament of tube V405.	a. 550 volts a-c, and filament of rectifier V405 glows. b. No voltage, and filament of rectifier V405 glows. c. No voltage, and filament of rectifier V405 does not glow.	a. Proceed to step 14. b. Check T403. Replace defective part and proceed to step 14. c. Check V405 and T403. Replace defective parts and proceed to step 14.
14	9 and gnd	Same as step 12	Same as step 6	a. +180 volts d-c b. No voltage or low voltage.	a. Proceed to step 15. b. Check L403 and C403. Replace defective parts and proceed to step 15.

TABLE 6-5

POWER SUPPLIES TROUBLE ANALYSIS CHART (cont)

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
15	(C11) and gnd	Multimeter 1000-volt d-c scale	Same as step 6	a. Approximately +240 ±10% volts dc	a. Proceed to step 20.
				b. Voltage too high or too low	b. Adjust resistor R419 as described in paragraph 6-16, and check R415, R418, R419, R420, and C410. If correct voltage not obtained, proceed to step 16.
				c. No voltage	c. Trouble in +260-volt d-c supply. Proceed to step 16.
16	(C1)	Same as step 13	Same as step 6	a. 900 volts a-c	a. Proceed to step 17.
				b. No voltage	b. Check T401. Replace defective part and proceed to step 17.
17	(C2)	Multimeter 10-volt a-c scale	Same as step 6	a. 5 volts a-c	a. Proceed to step 18.
				b. No voltage	b. Check V402 and T401. Replace defective parts and proceed to step 18.
18	(C7)	Same as step 15	Same as step 6	a. +330 volts d-c	a. Proceed to step 19.
				b. No voltage or low voltage	b. Check V401, L401, C401A, and C406. Replace defective parts and proceed to step 19.
19	(C9) and gnd	Multimeter 250-volt d-c scale	Same as step 6	a. +80 volts d-c	a. Repeat step 15.
				b. No voltage	b. Check V407, V408, R414, R404, R405, R410, and R411. Replace defective parts and repeat step 15.
				c. Intermittent voltage	c. Check C408 and V409. Replace defective part and repeat step 15.
20	(C12) and gnd	Multimeter 1000-volt d-c scale	Same as step 6	a. +240 volts d-c	a. Power supplies trouble-shooting completed, see paragraph 6-16 for adjustments.
				b. Voltage too high or too low	b. Adjust resistor R422 as described in paragraph 6-16 and check R417, R421, R422, R423, C411. If correct voltage not obtained proceed to step 21.
				c. No voltage	c. Trouble in +240-volt d-c supply. Proceed to step 21.

TABLE 6-5

POWER SUPPLIES TROUBLE ANALYSIS CHART (cont)

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
21	(C3)	Multimeter 1000-volt a-c scale	Same as step 6	a. 900 volts a-c b. No voltage	a. Proceed to step 22. b. Check T402. Replace defective part and proceed to step 22.
22	(C4)	Multimeter 10-volt a-c scale	Same as step 6	a. 5 volts a-c b. No voltage	a. Proceed to step 23. b. Check V404 and T402. Replace defective parts and proceed to step 23.
23	(C8)	Multimeter 1000-volt d-c scale	Same as step 6	a. 330 volts d-c b. No voltage or low voltage	a. Proceed to step 24. b. Check V403, L402, C401B, and C407. Replace defective parts and proceed to step 24.
24	(C10) and gnd	Multimeter 250-volt d-c scale	Same as step 6	a. +80 volts d-c b. No voltage c. Intermittent voltage	a. Repeat step 20. b. Check V410, V411, R416, R406, R407, R412, and R413 Replace defective parts and repeat step 20. c. Check C409 and V412. Replace defective part and repeat step 20.

TABLE 6-6

AUDIO UNIT TROUBLE ANALYSIS CHART

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
1	(A) and gnd	Multimeter 250-volt d-c scale	Set power switch (S401) to ON and MODULATION SELECTOR (S101) to 400∿ position. Measure voltage between test points.	a. -150 volts d-c b. No voltage or low voltage	a. Proceed to step 2. b. Trouble in power supplies, see table 6-5, or check J407 and P101. Replace defective parts and proceed to step 2.
2	(B) and gnd	Same as step 1	Same as step 1	a. +240 volts d-c b. No voltage or low voltage	a. Proceed to step 3. b. Trouble in power supplies, see table 6-5, or check J407 and P101. Replace defective parts and proceed to step 3.

TABLE 6-6

AUDIO UNIT TROUBLE ANALYSIS CHART (cont)

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
3	(C) and gnd	Multimeter 10-volt a-c scale	Same as step 1	a. 3.15 volts a-c b. No voltage or low voltage	a. Proceed to step 4. b. Trouble in power supplies, see table 6-5, or check J407 and P101. Replace defective parts and proceed to step 4.
4	(D) and gnd	Same as step 3	Same as step 1	a. 3.15 volts a-c b. No voltage or low voltage	a. Proceed to step 5. b. Trouble in power supplies, see table 6-5, or check J407 and P101. Replace defective parts and proceed to step 5.
5	(E)	Same as step 3	Same as step 1	a. 6.3 volts a-c b. No voltage or low voltage	a. Proceed to step 6. b. Trouble in power supplies, see table 6-5, or check J407 and P101. Replace defective parts and proceed to step 6.
6	(A1) and gnd	Multimeter 250-volt d-c scale	Same as step 1	a. +215 volts d-c b. No voltage or low voltage	a. Proceed to step 7. b. Check R108 or C106A. Replace defective parts and proceed to step 7.
7	(3)	Oscilloscope	Same as step 1, with DEVIATION RANGE (S102) in 150 position and then in 300 position and DEVIATION LEVEL (R114) fully clockwise.	a. 1.5 volts, 400 cps and 2.0 volts, 400 cps b. No voltage in either case	a. Proceed to step 8. b. Proceed to step 11.
8	None	None	Same as step 7. Zero MODULATION meter (M101) and observe its reading on operation of DEVIATION LEVEL control (R119).	a. MODULATION meter (M101) reads from zero to full scale corresponding to position of DEVIATION LEVEL control (R119). b. Meter does not function as in a above.	a. Proceed to step 9. b. Proceed to step 19.

TABLE 6-6

AUDIO UNIT TROUBLE ANALYSIS CHART (cont)

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
9	(A10)	Oscilloscope	Set power switch (S401) to ON, MODULATION SELECTOR (S101) to EXT, and connect source of 0.8 volt, 400 cps to MODULATION IN jack (J101). Measure voltage between test points.	a. 0.5 volt, 400 cps b. No voltage	a. Proceed to step 10. b. Proceed to step 21.
10	(A10)	Oscilloscope	Set power switch to ON, MODULATION SELECTOR (S101) to COMPRESSOR, and connect source of 6.0 volts, 400 cps to MODULATION IN jack (J101). Measure voltage between test points.	a. 0.5 volt, 400 cps b. No voltage	a. Troubleshooting completed; see paragraph 6-22 for adjustment of audio unit. b. Proceed to step 25.
11	(A2) and gnd	Multimeter 10-volt d-c scale	Same as step 1 and with identical measurement when MODULATION SELECTOR (S101) is in ON position.	a. +1.8 volts d-c in both 400Ω and 1000Ω positions of MODULATION SELECTOR (S101) b. Any voltage in a above, absent or low	a. Proceed to step 12. b. Check RT101, R105, R106, R107, and V101. Replace defective parts and proceed to step 12.
12	(A3) and gnd	Multimeter 250-volt d-c scale	Same as step 1	a. +170 volts d-c b. No voltage or wrong voltage	a. Proceed to step 13. b. Check R109, R110, R111, C107, and C109. Replace defective parts and proceed to step 13.
13	(A2) and gnd	Oscilloscope and frequency counter.	Same as step 11	a. 2 volts at 400 ±8 cps and 2 volts at 1000 ±20 cps b. No voltage or wrong frequency	a. Proceed to step 14. b. Check C101, C102, C103, C104, C105, R101, R102, R103, R104, R105, R106, S101A, and S101B. Replace defective parts and proceed to step 14.
14	(A11) and gnd	Multimeter 250-volt d-c scale	Same as step 1 with DEVIATION RANGE (S102) in 50 position and DEVIATION LEVEL (R119) fully clockwise	a. +80 volts d-c b. No voltage	a. Proceed to step 15. b. Check R167, R168, R169 and V110. Replace defective parts and proceed to step 15.

TABLE 6-6

AUDIO UNIT TROUBLE ANALYSIS CHART (cont)

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
15	(A11) and gnd	Oscilloscope	Same as step 14	a. 0.5 volt, 400 cps b. No voltage	a. Proceed to step 16. b. Check C108, C129, R112, R113, R119, R161, S101E, S102, and V110. Replace defective parts and proceed to step 16.
16	(A11) and gnd	Oscilloscope	Same as step 1 with DEVIATION RANGE (S102) in 150 position and then in 300 position. DEVIATION LEVEL (R119) fully clockwise.	a. 1.5 volts, 400 cps and 2.0 volts, 400 cps b. No voltage in either case	a. Proceed to step 17. b. Check R161, R162, R163, and S102. Replace defective parts and proceed to step 17.
17	(A10) and gnd	Multimeter 250-volt d-c scale	Same as step 14	a. +80 volts d-c b. No voltage	a. Proceed to step 18. b. Check R164, R165, R166, and V110. Replace defective parts and proceed to step 18.
18	(A10) and gnd	Oscilloscope	Same as step 14	a. 9.5 volts, 400 cps b. No voltage	a. Proceed to step 8. b. Check C128 and V110. Replace defective parts and proceed to step 8.
19	(A12) and gnd	Multimeter 250-volt d-c scale	Same as step 14	a. +125 volts d-c b. No voltage	a. Proceed to step 20. b. Check R170, R171, R172, R173, and V111. Replace defective parts and proceed to step 20.
20	None	None	Same as step 10. Zero MODULATION meter (M101). Observe operation of MODULATION meter (M101) on operation of DEVIATION LEVEL control (R119).	a. MODULATION meter (M101) reads from zero to full scale corresponding to position of DEVIATION LEVEL control (R119). b. MODULATION meter (M101) does not function. c. MODULATION meter (M101) does not read full scale when DEVIATION LEVEL control (R119) is in fully clockwise position.	a. Proceed to step 9. b. Check parts in vtvm circuit: C131, C132, R174, R175, R176, R177, R178, R179, R180, R181, R182, R183, V107, and V112. Replace defective parts and proceed to step 9. c. Recalibrate vtvm circuit, see paragraph 6-22, and proceed to step 9.

TABLE 6-6

AUDIO UNIT TROUBLE ANALYSIS CHART (cont)

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
21	(A9) and gnd	Multimeter 250-volt d-c scale	Set power switch (S401) to ON, MODULATION SELECTOR (S101) to EXT, and connect source of 0.8 volt, 400 cps to MODULATION IN jack (J101). Measure voltage between test points.	a. +180 volts d-c b. No voltage	a. Proceed to step 22. b. Check R119, R156, R157, R158, R159, R160, S101E, and V109. Replace defective parts and proceed to step 22.
22	(A9) and gnd	Oscilloscope	Same as step 21	a. 0.0023 volt, 400 cps b. No voltage	a. Proceed to step 23. b. Check C110, C127, R114, R115, S101C, S101E, and V109. Replace defective parts and proceed to step 23.
23	(A10) and gnd	Oscilloscope	Same as step 21	a. 0.5 volt, 400 cps b. No voltage	a. Proceed to step 10. b. Check C126 and replace if defective. Proceed to step 10.
24	4 and gnd	Multimeter 25-volt d-c scale	Set power switch (S401) to ON, MODULATION SELECTOR (S101) to COMPRESSOR, and with 1 volt, 10,000 cps input to MODULATION IN 560Ω (J101). Measure voltage between test points.	a. -10 volts d-c b. No voltage or wrong voltage	a. Proceed to step 10. b. Suppressor-grid bias adjustment required, see paragraph 6-22. Make adjustment. If correct voltage not obtained, proceed to step 25.
25	(A4) and gnd	Multimeter 250-volt d-c scale	Same as step 24	a. +140 volts d-c b. No voltage or wrong voltage	a. Proceed to step 27. b. Check C112A, C113, R120, R122, R124, R126, and V102. Replace defective parts. If trouble not corrected, proceed to step 26.
26	Pin 5, V103 and gnd	Multimeter 250-volt d-c scale	Same as step 24	a. +140 volts d-c b. No voltage or wrong voltage	a. Repeat steps 24 and 25. b. Check C106B, R127, R128, R129, R130, and V103. Replace defective parts and repeat step 25.
27	(A5) and gnd	Multimeter 250-volt d-c scale	Same as step 24	a. +140 volts d-c b. No voltage or wrong voltage	a. Proceed to step 29. b. Check C115, R131, R132, R133, R134, and V104. Replace defective parts. If trouble not corrected proceed to step 28.

TABLE 6-6

AUDIO UNIT TROUBLE ANALYSIS CHART (cont)

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
28	Pin 5, V105 and gnd	Multimeter 250-volt d-c scale	Same as step 24	a. +140 volts d-c b. No voltage or wrong voltage	a. Repeat steps 24 and 27. b. Check C112B, C121, R135, R136, R137, and V105. Replace defective parts and repeat step 27.
29	(A5) and gnd	Oscilloscope	Same as step 24	a. 0.03 volt, 10,000 cps b. No voltage	a. Proceed to step 30. b. Check C110, C116, R114, R115, R121, S101C, and S101D. Replace defective parts and proceed to step 30.
30	(A5) and gnd	Oscilloscope	Set power switch (S401) to ON, MODULATION SELECTOR (S101) to COMPRESSOR, and with 1 volt, 10,000 cps input to MODULATION IN 20K Ω (J102). Measure voltage between test points.	a. 0.03 volt, 10,000 cps b. No voltage	a. Proceed to step 31. b. Check C111, R116, R117, and R118. Replace defective parts and proceed to step 31.
31	(A6) and gnd	Multimeter 250-volt d-c scale	Same as step 30	a. +125 volts, d-c b. No voltage or wrong voltage	a. Proceed to step 32. b. Check R138, R139, R140, R141, and V106. Replace defective parts and proceed to step 32.
32	(A6) and gnd	Oscilloscope	Same as step 30	a. 0.063 volt, 10,000 cps b. No voltage	a. Proceed to step 33. b. Check C119, C120, and V106. Replace defective parts and proceed to step 33.
33	(A7) and gnd	Multimeter 100-volt d-c scale	Same as step 30	a. +21.5 volts d-c b. No voltage or wrong voltage	a. Proceed to step 34. b. Check R145, R146, R147, and V108. Replace defective parts and proceed to step 34.
34	(A7) and gnd	Oscilloscope	Same as step 30	a. 0.0052 volt, 10,000 cps b. No voltage	a. Proceed to step 35. b. Check C123, C124, R142, R144, R145, R146, V107A, and V108. Replace defective parts and proceed to step 35.
35	(A8) and gnd	Multimeter 250-volt d-c scale	Same as step 30	a. +140 volts d-c b. No voltage or wrong voltage	a. Proceed to step 10. b. Check C122, C123, R143, R153, R154, R155, and V109. Replace defective parts and proceed to step 10.

TABLE 6-7

F-M UNIT TROUBLE ANALYSIS CHART

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
1	(W) E of P511	Vtvm (D-c range)	Power switch ON. Measure voltage between test point and ground.	a. -150 volts d-c b. No voltage or wrong voltage	a. Proceed to step 5. b. Refer to table 6-5.
2	(X) D of P511	Same as step 1	Same as step 1	a. +240 volts d-c b. No voltage or wrong voltage	a. Proceed to step 5. b. Refer to table 6-5.
3	(Y) F of P511	Vtvm (A-c range)	Same as step 1	a. 6.3 volts a-c b. No voltage or wrong voltage	a. Proceed to step 5. b. Refer to table 6-5.
4	(Z) L of P511	Same as step 3	Same as step 1	a. 6.3 volts a-c b. No voltage or wrong voltage	a. Proceed to step 5. b. Refer to table 6-5.
5	(11) J201	Vtvm (r-f range with r-f probe)	Tune AFC control. Measure voltage between test point and ground.	a. 0.4 volt r-f b. No voltage or wrong voltage	a. Proceed to step 6. b. Check V202A and V201, and associated circuitry or alignment (see paragraph 6-44). Replace defective part and proceed to step 6.
6	(D2) Arm of R260	Vtvm (D-c range)	Set MODULATION SELECTOR to 1000 Ω, and DEVIATION LEVEL control fully clockwise. Position DEVIATION RANGE to 300 position. Measure voltage between test point and ground.	a. +0.9 volt d-c b. No voltage or wrong voltage	a. Proceed to step 17. b. Adjust R260, then proceed to step 7.
7	(CC) J201	Same as step 6	Same as step 6	a. +160 volts d-c b. No voltage or wrong voltage	a. Proceed to step 8. b. Check tube V212, and associated circuitry. Then proceed to step 8.
8	(BB) J203	Same as step 6	Same as step 6	a. +120 volts d-c b. No voltage or wrong voltage	a. Proceed to step 9. b. Check V211, V210, V209, and V208. Check associated circuitry and proceed to step 9.

TABLE 6-7

F-M UNIT TROUBLE ANALYSIS CHART (cont)

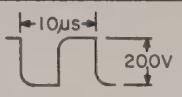
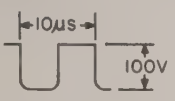
Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
9	(D10) Pin 5 of V207	Oscilloscope	Observe waveshape between test point and ground.	a.  b. No waveshape or distorted waveshape	a. Proceed to step 17. b. Check V207, and check associated circuitry or alignment (see paragraph 6-27). Then proceed to step 10.
10	(D9) Pin 5 of V206	Same as step 9	Same as step 9	a.  b. No waveshape or wrong waveshape	a. Proceed to step 11. b. Check V206, and associated circuitry or alignment (see paragraph 6-27). Then proceed to step 11.
11	(D8) Pin 1 of V203B	Vtvm (d-c range)	Same as step 6	a. +105 volts d-c b. No voltage or wrong voltage	a. Proceed to step 2. b. Check V203B, and associated circuitry. Then proceed to step 12.
12	(D7) Pin 1 of V204B	Same as step 11	Same as step 6	a. +130 volts d-c b. No voltage or wrong voltage	a. Proceed to step 15. b. Check V204B, and associated circuitry. Then proceed to step 15.
13	(D6) Pin 6 of V205	Same as step 11	Same as step 6	a. +170 volts d-c b. No voltage or wrong voltage	a. Proceed to step 15. b. Check V205, and associated circuitry or alignment (see paragraph 6-27). Then proceed to step 15.
14	(AA) Pin 7 of V204A	Same as step 11	Same as step 6	a. 0.8 volt d-c b. No voltage or wrong voltage	a. Proceed to step 15. b. Check V205, 47.9 mc crystal, and associated circuitry. Then proceed to step 15.
15	(D5) Pin 6 of V204A	Same as step 11	Same as step 6	a. +170 volts d-c b. No voltage or wrong voltage	a. Proceed to step 16. b. Check V204A, and associated circuitry. Then proceed to step 16.

TABLE 6-7

F-M UNIT TROUBLE ANALYSIS CHART (cont)

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
16	(D4) Pin 6 of V203A	Same as step 11	Same as step 6	a. +220 volts d-c b. No voltage or wrong voltage	a. Proceed to step 17. b. Check V203A, and associated circuitry or alignment (see paragraph 6-27). Then proceed to step 17.
17	(D3) Pin 1 of V202B	Same as step 11	Same as step 6	a. +220 volts d-c b. No voltage or wrong voltage	a. Proceed to step 18. b. Check V202B, and associated circuitry or alignment (see paragraph 6-27). Then proceed to step 18.
18	(12)	Ballantine 300	Same as step 6	a. 0.5 volt d-c b. No voltage or wrong voltage	a. Troubleshooting completed. See paragraph 6-27 for alignment of f-m unit. b. Refer to table 6-6.

TABLE 6-8

R-F UNIT TROUBLE ANALYSIS CHART

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
1	(F) Terminal S of r-f filter	Vtvm (a-c range)	Set power switch to ON. Measure voltage between test point and ground.	a. 120 volts a-c b. No voltage or wrong voltage	a. Proceed to step 2. b. Refer to table 6-5.
2	(G) Terminal N of r-f filter	Same as step 1	Same as step 1	a. 6.3 volts a-c b. No voltage or wrong voltage	a. Proceed to step 3. b. Refer to table 6-5.
3	(J) Pin 4 of V510	Same as step 1	Same as step 1	a. 6.3 volts a-c b. No voltage or wrong voltage	a. Proceed to step 4. b. Refer to table 6-5.

TABLE 6-8

R-F UNIT TROUBLE ANALYSIS CHART (cont)

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
4	(H)	Vtvm (d-c range)	Same as step 1	a. Approximately +240 ±10% volts d-c	a. Proceed to step 5.
	Terminal B of r-f filter			b. No voltage or voltage too high or too low	b. Refer to table 6-5.
5	(6) J506	Vtvm (r-f range with r-f probe)	Set operation selector switch to VFO, and RF LEVEL switch to HI. Measure voltage between test point and ground. NOTE Indication depends on operating frequency.	a. 1.5 to 3 volts r-f b. No voltage or wrong voltage	a. Proceed to step 6. b. Check V509, and associated circuitry or alignment (see paragraph 6-44). Replace defective parts and proceed to step 6.
6	(6) J506	Bolometer and Bolometer Mount (see figure 6-2)	Set LEVEL CONTROL to LO.	a. 1 to 100,000 uv b. No output or wrong output	a. Proceed to step 21. b. Check piston attenautor and S504. Replace defective parts and proceed to step 7.
7	(B11) Junction of C600 and R539	Vtvm (r-f range with r-f probe)	Same as step 5	a. 0.8 to 2.5 volts r-f b. No voltage or wrong voltage	a. Proceed to step 8. b. Check V508, and associated circuitry or alignment (see paragraph 6-44). Replace defective parts and proceed to step 8.
8	(B10) Junction of L552 and C674	Same as step 7	Same as step 5	a. 1 to 3 volts r-f b. No voltage or wrong voltage	a. Proceed to step 9. b. Check V507, and associated circuitry or alignment (see paragraph 6-44). Replace defective parts and proceed to step 9.
9	(B9) Pin 1 of V507	Same as step 7	Same as step 5	a. 1 to 1.5 volts r-f b. No voltage or wrong voltage	a. Proceed to step 10. b. Check V506, and associated circuitry or alignment (see paragraph 6-44). Replace defective parts and proceed to step 10.
10	(B8) Pin 7 of V506	Same as step 7	Same as step 5	a. 2 to 4 volts r-f b. No voltage or wrong voltage	a. Proceed to step 11. b. Check V505, V514, and associated circuitry or alignment (see paragraph 6-44). Replace defective parts and proceed to step 11.

TABLE 6-8

R-F UNIT TROUBLE ANALYSIS CHART (cont)

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
11		Refer to table 6-7.	Refer to table 6-7.	a. 48 mc ±0.002% b. Refer to table 6-7.	a. Proceed to step 12. b. Refer to table 6-7. Replace defective parts and proceed to step 12.
12	B7 Pin 1 of V514	Vtvm (r-f range with r-f probe)	Same as step 5	a. 2 to 4 volts r-f b. No voltage or wrong voltage	a. Proceed to step 13. b. Check V504, V513, and associated circuitry or alignment (see paragraph 6-44). Replace defective parts and proceed to step 12.
13	B6 Pin 1 of V504	Same as step 12	Same as step 5	a. 2 to 4 volts r-f b. No voltage or wrong voltage	a. Proceed to step 14. b. Check V503, and associated circuitry or alignment (see paragraph 6-44). Replace defective parts and proceed to step 12.
14	B5 Pin 7 of V506	Same as step 12	Same as step 5	a. 1 to 2 volts r-f b. No voltage or wrong voltage	a. Proceed to step 21. b. Check V502, and associated circuitry or alignment (see paragraph 6-44). Replace defective parts and proceed to step 12.
15	M J508	Same as step 12	Same as step 5	a. 0.1 to 0.2 volt r-f b. No voltage or wrong voltage	a. Proceed to step 16. b. Check V510, and associated circuitry or alignment (see paragraph 6-44). Replace defective parts and proceed to step 16.
16	B1 Pin 1 of V510	Vtvm (d-c range)	Same as step 5	a. -2 to -9 volts d-c b. No voltage or wrong voltage	a. Proceed to step 17. b. Check tens crystals, and associated circuitry. Replace defective parts and proceed to step 17.
17	O J507	Vtvm (r-f range with r-f probe)	Same as step 5	a. 0.4 to 0.9 volt r-f b. No voltage or wrong voltage	a. Proceed to step 19. b. Check V512, and associated circuitry or alignment (see paragraph 6-44). Replace defective parts and proceed to step 18.

TABLE 6-8

R-F UNIT TROUBLE ANALYSIS CHART (cont)

Step	Test Point	Test Equipment	Control Settings and Instructions	Indication	Procedure
18	(B3) Junction of C612 and L558	Vtvm (d-c range)	Same as step 5	a. -1 to -2.5 volts d-c b. No voltage or wrong voltage	a. Proceed to step 19. b. Check V512, and associated circuitry or alignment (see paragraph 6-44). Replace defective parts and proceed to step 19.
19	(N) J509	Vtvm (r-f range with r-f probe)	Same as step 5	a. 0.8 to 1 volt r-f b. No voltage or wrong voltage	a. Proceed to step 20. b. Check V511, and associated circuitry, or alignment (see paragraph 6-44). Replace defective parts and proceed to step 20.
20	(B2) Pin 1 of V511	Vtvm (d-c range)	Same as step 5	a. -10 to -20 volts d-c b. No voltage or wrong voltage	a. Proceed to step 21. b. Check units crystals, and alignment (see paragraph 6-44).
21	(B13) Pin 8 of V515	Same as step 20	Same as step 5	a. +3.5 volts d-c b. No voltage or wrong voltage	a. Proceed to step 22. b. Check V515, and associated circuitry or alignment (see paragraph 6-44). Replace defective parts and proceed to step 22.
22	(B12) Pin 2 of V516	Same as step 20	Same as step 5	a. +90 volts d-c b. No voltage or wrong voltage	a. Proceed to step 23. b. Check V516, and refer to paragraphs 6-22 and 6-27. Proceed to step 23.
23	(L) Pin H of P510	Vtvm (a-c range)	Same as step 5	a. 6.3 volts a-c b. No voltage or wrong voltage	a. Proceed to step 24. b. Refer to table 6-5.
24	(K) Pin A of P510	Vtvm (d-c range)	Same as step 5	a. 0 to 0.1 volt d-c b. No voltage or wrong voltage	a. Troubleshooting completed. See paragraph 6-44 for alignment of r-f unit. b. Check setting of POWER SET control. Refer to paragraph 6-16.

TABLE 6-9

VACUUM TUBE VOLTAGES

Reference Symbol	Tube Type	Pin								
		1	2	3	4	5	6	7	8	9
NOTE Unless otherwise specified, all voltages are expressed as positive volts d-c, and are measured with respect to ground, using the test equipment listed in Section II.										
Audio Unit[1]										
V101	12AT7WA	165	0	1.86	6.5 a-c	6.5 a-c	80	0	1.15	0
V102	6AU6WA	0	-0.5	3 a-c	3 a-c	140	140	1.80	--	--
V103	6AU6WA	0	-0.5	3 a-c	3 a-c	140	140	1.80	--	--
V104	6AU6WA	0	-0.5	3 a-c	3 a-c	140	140	1.65	--	--
V105	6AU6WA	0	-0.5	3 a-c	3 a-c	140	140	1.7	--	--
V106	12AT7WA	205	125	126	3 a-c	3 a-c	125	0	1.1	3 a-c
V107	5726	0	0	3 a-c	3 a-c	-0.15	0	0.15	--	--
V108	12AT7WA	22	-0.2	0	3 a-c	3 a-c	178	22	47	3 a-c
V109	12AT7WA	130	0	1.6	3 a-c	3 a-c	131	0	1.55	3 a-c
V110	5814A	205	30	80	3 a-c	3 a-c	205	30	80	3 a-c
V111	12AT7WA	205	116	118	6.5 a-c	6.5 a-c	116	0	1.2	0
V112	12AT7WA	200	0	3.6	6.5 a-c	6.5 a-c	205	0	3.6	0
F-m Unit[2]										
V201	6AH6	-0.3	3.4	0	6.2 a-c	155	190	3.4	--	--
V202	5814A	230	0	8	0	0	155	-4	0	6.1 a-c
V203	12AT7WA	180	-4.1	0	0	0	235	0	2.6	6.1 a-c
V204	5751	135	-0.5	0	0	0	178	0	2.45	6.1 a-c
V205	12AT7WA	190	0	1.8	0	0	188	0	2.3	6.1 a-c
V206	6AH6	-28	0	0	6.2 a-c	130	75	0	--	--
V207	6005	-100	0	0	6.2 a-c	145	102	nc	--	--
V208	5726	-34	-34	6.6 a-c	0	62	nc	-150	--	--
V209	5726	52	53	0	6.6 a-c	52	nc	52	--	--
V210	5726	53	52	6.6 a-c	0	53	nc	52	--	--

TABLE 6-9

VACUUM TUBE VOLTAGES (cont)

Reference Symbol	Tube Type	Pin								
		1	2	3	4	5	6	7	8	9
F-m Unit[2] (cont)										
V211	5751	235	55	57	0	0	120	55	57	6.6 a-c
V212	5751	235	118	120	0	0	150	120	120	6.6 a-c
Power Supplies[3]										
V401	5R4WGB	nc	840 a-c	nc	470 a-c	nc	470 a-c	nc	840 a-c	--
V402	5NO45T	840 a-c	nc	840 a-c	840 a-c	nc	840 a-c	840 a-c	840 a-c	840 a-c
V403	5R4WGB	nc	840 a-c	nc	470 a-c	nc	470 a-c	nc	840 a-c	--
V404	5NO45T	840 a-c	nc	840 a-c	840 a-c	nc	840 a-c	840 a-c	840 a-c	840 a-c
V405	5Y3WGTA	nc	520 a-c	nc	260 a-c	225	260 a-c	nc	520 a-c	--
V406	5896	-340	390 a-c	6.5 a-c	nc	390 a-c	0	0	nc	--
V407	6080WA	190	360	238	190	360	238	6.4 a-c	0	--
V408	6AU6WA	85	85	0	6.4 a-c	190	150	85	--	--
V409	5651WA	85	nc	nc	nc	nc	nc	0	--	--
V410	6080WA	210	360	240	210	360	240	6.4 a-c	0	--
V411	6AU6WA	85	85	0	6.5 a-c	210	155	85	--	--
V412	5651WA	85	nc	nc	nc	85	nc	0	--	--
V413	0A2WA	0	nc	nc	-145	nc	nc	nc	--	--
R-f Unit[4]										
V501	5718	0	0	0	0	1.1	6.2 a-c	0	95	--
V502	5725	0	1.8	0	6.2 a-c	152	120	0	--	--
V503	5654	0	1.68	0	6.2 a-c	140	110	1.68	--	--
V504	5654	-1.9	0	0	6.2 a-c	100	38	0	--	--
V505	5654	-5.3	0	0	6.2 a-c	130	62	0	--	--
V506	5725	-1.15	0	0	6.2 a-c	142	112	0	--	--
V507	5654	0	2.1	0	6.1 a-c	120	120	nc	--	--
V508	6AN4	195	0	0	6.1 a-c	1.75	0	195	--	--

TABLE 6-9

VACUUM TUBE VOLTAGES (cont)

Reference Symbol	Tube Type	Pin								
		1	2	3	4	5	6	7	8	9
R-f Unit[4] (cont)										
V509	6AN4	230	--	0	6.1 a-c	2.1	0	230	--	--
V510	6AU6WA	-0.1	0	0	6.2 a-c	240	150	0.1	--	--
V511	6AU6WA	-0.1	0	0	6.2 a-c	240	128	0.1	--	--
V512	6AH6	-5	0	0	6.2 a-c	240	125	0.5	--	--
V513	5654	-1.45	0	0	6.2 a-c	100	62	0	--	--
V514	5654	-4.6	0	0	6.2 a-c	130	52	0	--	--
V515	12AT7WA	240	0	4.4	6.3 a-c	6.3 a-c	240	-0.3	4.4	0
V516	6E5	0	120	0	240	8	6.3 a-c	--	--	--

NOTES

1. Measurements made with controls and indicators set as follows:

Control or Indicator	Position
MODULATION SELECTOR (S101)	COMPRESSOR
DEVIATION LEVEL (R119)	Fully counterclockwise
DEVIATION RANGE (S102)	300
MODULATION IN jacks (J101, J102)	Not used

2. Measurements made with controls and indicators set as follows:

Control or Indicator	Position
TUNE AFC (C215, S201)	IN

3. Measurements made with controls and indicators set as follows:

Control or Indicator	Position
Power switch (S401)	ON

4. Measurements made with controls and indicators set as follows:

Control or Indicator	Position
CARRIER MONITOR (M501)	Red line
OPERATION SELECTOR (S501)	XTAL
TENS and UNITS controls	400 mc
RF LEVEL (S504)	LO
ATTENUATOR (Z501)	100,000 uv

TABLE 6-10

VACUUM TUBE RESISTANCES

Reference Symbol	Tube Type	Pin								
		1	2	3	4	5	6	7	8	9
NOTE Unless otherwise specified, all resistances are expressed in ohms, kilohms (k), and megohms (m), and are measured with respect to ground, using the test equipment listed in section II.										
Audio Unit[1]										
V101	12AT7WA	50k	220k	470	1	1	110k	0	400	0
V102	6AU6WA	1.5k	2.5m	11.5	11.5	50k	50k	220	--	--
V103	6AU6WA	1.5k	2.5m	11.5	11.5	50k	50k	220	--	--
V104	6AU6WA	1m	2.5m	11.5	11.5	50k	50k	220	--	--
V105	6AU6WA	1m	2.5m	11.5	11.5	50k	50k	200	--	--
V106	12AT7WA	40k	65k	47k	11.5	11.5	65k	1m	300	11.5
V107	5726	100k	100k	11.5	11.5	10m	0	10m	--	--
V108	12AT7WA	1m	0.8m	0	11.5	11.5	250k	1m	10k	11.5
V109	12AT7WA	65k	30k	470	11.5	11.5	65k	47k	470	11.5
V110	5814A	40k	1m	19.5k	11.5	11.5	40k	1m	19.5k	11.5
V111	12AT7WA	40k	65k	47k	1	1	65k	1m	300	0
V112	12AT7WA	45k	1m	1.1k	1	1	43k	450k	1.1k	0
F-m Unit[2]										
V201	6AH6	0.8m	300	0	0	18k	18k	300	--	--
V202	5814A	14k	0	1k	0	0	18k	47k	0	0
V203	12AT7WA	23k	22k	0	0	0	14k	0	330	0
V204	5751	68k	47k	0	0	0	65k	22k	2.2k	0
V205	12AT7WA	18k	0	330	0	0	18k	10k	330	0
V206	6AH6	47k	0	0	0	24k	63k	0	--	--
V207	6005	15k	0	0	0	16k	46k	nc	--	--
V208	5726	inf	inf	0.5	0	110k	nc	420k	--	--
V209	5726	inf	110k	0	0.5	inf	nc	115k	--	--
V210	5726	118k	inf	0.5	0	118k	nc	inf	--	--
V211	5751	14k	120k	22k	0	0	0.7m	340k	22k	0.5
V212	5751	14k	63k	68k	0	0	0.6m	0.7m	68k	0.5

TABLE 6-10

VACUUM TUBE RESISTANCES (cont)

Reference Symbol	Tube Type	Pin								
		1	2	3	4	5	6	7	8	9
Power Supplies[3]										
V401	5R4WGB	nc	260k	nc	45	nc	50	nc	inf	---
V402	5NO45T	260k	nc	260k	260k	nc	260k	260k	260k	260k
V403	5R4WGB	nc	240k	nc	50	nc	45	nc	inf	--
V404	5NO45T	240k	nc	240k	240k	nc	240k	240k	240k	240k
V405	5Y3WGTA	nc	20k	nc	200	20k	200	nc	20k	--
V406	5896	0.75m	0.8m	0	nc	0.8m	0	0	nc	--
V407	6080WA	1.8m	260k	78k	1.8m	260k	78k	0	0	--
V408	6AU6WA	150k	140k	0	0	1.8m	38k	140k	--	--
V409	5651WA	140k	nc	nc	nc	nc	nc	0	--	--
V410	6080WA	1.8m	240k	16k	1.8m	240k	16k	0	0	--
V411	6AU6WA	48k	75k	0	0	1.8m	21k	75k	--	--
V412	5651WA	75k	nc	nc	nc	inf	nc	0	--	--
V413	0A2WA	0	nc	nc	0.8m	nc	nc	nc	--	--
R-f Unit[4]										
V501	5718	0	0	0	0	110	0	0	85k	--
V502	5725	20	200	0	0	80k	75k	25	--	--
V503	5654	220k	180	0	0	80k	95k	180	--	--
V504	5654	1.5k	0	0	0	90k	290k	0	--	--
V505	5654	10k	0	0	0	78k	160k	0	--	--
V506	5725	120k	0	0	0	95k	110k	0	--	--
V507	5654	10k	180	0	0	80k	80k	nc	--	--
V508	6AN4	75k	0	0	0	150	0	75k	--	--
V509	6AN4	14k	0	0	0	180	0	14k	--	--
V510	6AU6WA	68k	0	0	0	13k	95k	11	--	--
V511	6AU6WA	68k	0	0	0	13k	95k	15	--	--
V512	6AH6	10k	0	0	0	13k	50k	15	--	--

TABLE 6-10

VACUUM TUBE RESISTANCES (cont)

Reference Symbol	Tube Type	Pin								
		1	2	3	4	5	6	7	8	9
R-f Unit[4] (cont)										
V513	5654	1.5k	0	0	0	90k	290k	0	--	--
V514	5654	10k	0	0	0	78k	160k	0	--	--
V515	12AT7WA	14k	1m	1k	0	0	15k	115k	1k	0
V516	6E5	0	1m	1m	14k	3.6k	0	--	--	--

NOTES

1. Measurements made with controls and indicators set as follows:

Control or Indicator	Position
DEVIATION LEVEL (R119)	Fully clockwise
DEVIATION RANGE (S102)	300
MODULATION SELECTOR (S101)	COMPRESSOR

2. Measurements made with controls and indicators set as follows:

Control or Indicator	Position
MODULATION IN jacks (J101, J102)	Not used
TUNE AFC (C215, S201)	In

3. Measurements made with controls and indicators set as follows:

Control or Indicator	Position
Power switch (S401)	ON

4. Measurements made with controls and indicators set as follows:

Control and Indicator	Position
POWER SET (R428, S507)	Fully clockwise
OPERATION SELECTOR (S501)	XTAL

6-16. ALIGNMENT AND ADJUSTMENT PROCEDURE.

6-17. ADJUSTMENT OF POWER SUPPLIES.

6-18. GENERAL. The following power supplies require adjustment: +260-volt regulated supply, +240-volt regulated supply, and the -150-volt regulated supply. There are no adjustments to be made on the +180-volt unregulated supply. The power supplies are to be adjusted under full-load conditions.

6-19. +260-VOLT SUPPLY. Adjust the +260-volt supply as follows:

a. Connect a vtvm between J104 (audio unit) and ground.

b. Adjust R419 (figure 6-16) until the vtvm indicates exactly -10 volts d-c.

6-20. +240-VOLT SUPPLY. Adjust the +240-volt supply as follows:

a. Connect a vtvm accurate within ±0.5% between pin 3 of V410 and ground.

b. Adjust R422 (figure 6-16) until the vtvm indicates exactly +240 volts d-c.

6-21. -150-VOLT SUPPLY. Adjust the -150-volt supply as follows:
a. Connect a 0- to 10-ma ammeter in series with voltage regulator tube V413 by either using an adapter or by unsoldering leads.
b. Adjust R408 (figure 6-37) until the ammeter indicates 117 volts a-c, 7-ma.

6-22. ADJUSTMENT OF AUDIO UNIT.

6-23. GENERAL. The procedure for adjusting the Audio Unit consists of adjusting the audio oscillator, adjusting the suppressor grid-voltage, and of zero-setting and calibrating the MODULATION meter. Check for an indication of -10 volts d-c at J104.

6-24. AUDIO OSCILLATOR V101. Adjustment is made in the following manner:
a. Connect an oscilloscope across R112 and R113.
b. Place switch S101D in 400 position.
c. Adjust R103 to optimize output level vs waveform distortion.
d. Repeat procedure of steps a and c with switch S101D in 1000 position.

6-25. COMPRESSOR SUPPRESSOR GRID-VOLTAGE ADJUSTMENT. Adjust as follows:
a. Connect an audio oscillator to the MODULATION IN 560 input jack and feed in 1 volt at 10,000 cycles.
b. Switch the MODULATION SELECTOR to COMPRESSOR.
c. Turn the DEVIATION LEVEL control to its full clockwise position.
d. Connect a vtvm between the DEVIATION OUT jack J103 and ground.
e. Adjust R145 for indication of 0.7 to 0.8 volt.

6-26. CALIBRATION OF MODULATION METER. Adjustment is made in the following manner:
a. Switch the MODULATION SELECTOR to OFF.
b. Adjust R180 (figure 6-17) for approximately zero reading.
c. Adjust R182, ZERO SET control, for an exact zero indication. The CARRIER MONITOR meter is now zeroed.
d. Connect a vtvm between deviation output jack J103 and ground.
e. Switch the MODULATION SELECTOR to 400 .
f. Set R119, DEVIATION LEVEL control, fully clockwise.
g. Set DEVIATION RANGE switch to 300 kc.
h. Adjust R119 for a 0.5-volt indication on the vtvm.
i. Adjust R176 (figure 6-17) for a deviation of 300 kc.

6-27. ALIGNMENT PROCEDURE FOR THE F-M UNIT.

6-28. GENERAL. The alignment procedure for the f-m unit consists of four major parts including the reference oscillator V205; circuitry from the reactance tube V201 to the last limiting amplifier V207; the peak-to-peak detector V208, counter V208, counter V209 and d-c amplifiers V211 and V212; and, lastly, the overall alignment.

NOTE

Before proceeding with the alignment procedures, be sure that the +240-volt d-c and -150-volt d-c supplies are at their proper voltages, respectively. See paragraph 6-17 for power supply adjustment.

6-29. REFERENCE OSCILLATOR V205. The following procedure is used to align the reference oscillator:
a. Allow sufficient time for the crystal to stabilize to the proper temperature.
b. Take the output of the reference oscillator through its output cable and feed it to the electronic counter.
c. Adjust L207 until the counter indicates 47.9 mc ±50 cps.

6-30. CIRCUITRY FROM V201 THROUGH V207. Use the following procedure for tuning the main oscillator V202A and the two buffer-stage tank circuits (plate circuits of V202B and V203A):
a. Adjust the 1000-ohm potentiometer R212 to 300 ohms. Determine the linearity of the potentiometer by rotation of the shaft.
b. Adjust R203 to indicate +0.9 volts d-c.
c. Adjust L203 near its center position.
d. Keep AFC DEFEAT switch in the DEFEAT position by any improvised way.
e. Tune the oscillator to 48 mc. Connect an electronic counter through a 6 db pad across C210. Adjust C210 for an indication of 48 mc ±100 kc. V201 should have a tube shield on.
f. Connect an r-f voltmeter probe, or an oscilloscope across C221.
g. Tune L205 and C224 for maximum response, while keeping frequency close to 48 mc. A signal of 100 kc should appear at the plate of mixer V204A. It will be amplified and limited as it passes through V204B, V203B, V206 and V207.
h. Use a scope with a high impedance probe to observe the output at the plate of V207. The output should be a square wave of approximately 200 volts peak amplitude. The symmetry of the square wave can be improved by adjusting R234.

6-31. PEAK-TO-PEAK DETECTOR V208, COUNTER V209, AND D-C AMPLIFIERS V211 AND V212. This part of the alignment is concerned with the adjustments of the following potentiometers: R245, R246, R249, R260 and R262. Align in the following manner:
a. TUNE AFC control in the defeat position.
b. Remove V211 and V212.
c. Set R249 fully clockwise.
d. Connect the electronic counter to the plate of V207 through a 5 uuf capacitor.
e. Adjust C210 or C215 to keep the difference frequency at 100 kc, ±200 cps.
f. Connect the common lead of the vtvm to the high side of C206B. Measure the voltage at the grids of V211 (pins 2 and 7). Set R246 fully counterclockwise and adjust R245 until the voltages on the grids are equal.

WARNING

A difference of potential exists between the vtvm cabinet and the signal generator.

g. Replace V211 and measure plate voltage at jack J203.
h. Adjust R262 until voltage at pin 2 of V212 reads the same as in step g.
i. Replace V212.
j. Measure the plate voltage at jack J204. The voltage should swing slightly above and below 160 volts d-c by varying C210 or C215 approximately ±100 kc.
k. Set R260 to its center position.
l. Replace the TUNE AFC control in the defeat position.
m. The electronic counter should indicate a frequency of approximately 48 mc.
n. Adjust R246 until the indicated frequency is 48 mc.

6-32. OVERALL ADJUSTMENT. The f-m unit is now operational. The following procedure is used to minimize incidental distortion and incidental a-m. Use the following procedure:
a. Feed a 0.5-volt, 1-kc modulating signal through C203 to V201. Check the resulting f-m deviation.
b. Adjust R212 until the 0.5-volt input produces a 75 kc deviation.
c. Measure the distortion of the detected f-m signal.
d. Adjust C210 or C215 to reduce distortion. If a large adjustment is made, the deviation sensitivity will be affected.
e. Repeat steps b, c, and d.
f. Feed the oscillator output to a full wave detector and measure the a-c to d-c output. Use the following equation:

$$\% \text{ AM} = \frac{\sqrt{2\ (\text{A-C})}}{\text{D-C}}$$

g. Adjust C220 until a-c output (step f) is minimum.
h. Repeat steps b, c, and d until distortion is minimum.
i. Measure and record the voltage reading across R264, which indicates the desirable operating point of the reactance tube.
j. Repeat step g.
k. Adjust the voltage across R203 to equal that of step i.
l. Vary the line voltage and observe the effect on output frequency. Adjust R249 to minimize this effect. After each adjustment of R249, adjustments of R245 and R246 should be made.

6-33. ALIGNMENT OF F-M UNIT AFTER TUBE CHANGE.

6-34. GENERAL. The changing of tubes in the f-m unit affects frequency, sensitivity, symmetry of output, and desired operating points. The following paragraphs describe the alignment and adjustment procedures after such changes are made.

6-35. REACTANCE TUBE V201. Check V201 in the following manner:
a. Connect the vtvm across R264 and adjust capacitor C210 until the vtvm indicates approximately 1 volt.
b. Feed a 1 kc modulated signal through C203 to V201. Check the resulting f-m deviation by an appropriate detecting system. (See table 2-1.) Adjust potentiometer R212 for a deviation of 75 kc.
c. Adjust C210 for minimum distortion.
d. Repeat steps b and c.
e. Connect the oscillator output to appropriate detector and measure the a-c and d-c outputs. Use the equation,

$$\% \text{ AM} = \frac{\sqrt{2\ (\text{A-C})}}{\text{D-C}}$$

to find the deviation amplitude distortion. Adjust C221 for a minimum a-c output.
f. Repeat steps b and c.
g. Measure the voltage across R264 (see step a) and record the indicated reading.
h. Adjust potentiometer R212 opening the electron-ray tube indication approximately 10°.
i. Repeat step e.
j. Place vtvm across potentiometer R203 and adjust so that the voltage is the same as in step g.
k. Check the output frequency with an electronic counter for an indication of approximately 48 mc. Adjust potentiometers R245 and R246 if necessary.

6-36. F-M OSCILLATOR AND BUFFER AMPLIFIER V202. The alignment and adjustment procedure is the same as for V201.

6-37. BUFFER AMPLIFIER V203. The effects of changing V203 are small. If adjustment is necessary proceed as follows:
a. Place the TUNE AFC control in the defeat position and tune the oscillator frequency to 48 mc. Disconnect reference oscillator input from V204.
b. Connect an oscilloscope across C225 and tune C224 for maximum response. Reconnect reference oscillator input.
c. Connect oscilloscope between pin 1 and ground and adjust R234 to improve the square wave symmetry.

6-38. REFERENCE OSCILLATOR V205. Check the frequency of the oscillator in the following manner:
a. Take the output through its output cable and feed it to an electronic counter. Adjust L207 until the counter indicates 47.9 mc ±50 cps.
b. Check the output frequency and adjust R245 and R246.

6-39. LIMITERS V206 and V207. Check the output frequency of the limiter tubes and adjust R245 and R246 if necessary.

6-40. PEAK-TO-PEAK DETECTOR V208. Check output frequency and adjust R245 and R246 if necessary.

6-41. FREQUENCY COUNTERS V209 AND V210. The frequency counters affect filament compensation as well as having some effect on output frequency. Use the following procedure:
a. Check the output frequency and adjust R245 and R246.
b. Vary the line voltage and observe the effect on output frequency. Adjust R249 to minimize this effect.
c. Repeat step a.

6-42. DIFFERENTIAL D-C AMPLIFIER V211. Perform the following procedure:
a. Remove V211 and V212.
b. Place the TUNE AFC control in the defect position.

c. Adjust tuning capacitor C210 or C215 keeping difference frequency close to 100 kc.
d. Adjust R245 to equalize the voltages on the two grids (pin 2 and pin 7) of V211. Connect the common lead of the vtvm to the high side of C244 to improve sensitivity.

WARNING

A difference of potential exists between the vtvm cabinet and the signal generator.

6-43. D-C AMPLIFIER V212. Check output frequency and adjust R245 and R246 if necessary.

6-44. R-F UNIT ALIGNMENT PROCEDURE.

6-45. GENERAL. The procedure for aligning the r-f unit consists of rechecking the 48-mc input from the f-m unit; adjusting the output of the units, tens, and interpolation oscillators; tracking the tuned stages from input to output; and reducing spurious f-m and a-m. The r-f and f-m unit assembly must be removed from the signal generator before the procedure outlined below can be performed.

NOTE

Do not attempt to align the r-f unit until the alignment of the f-m unit (paragraph 6-27) has been completed.

TABLE 6-11

R-F UNIT TRACKING PROCEDURE

Stage	Coil Frequencies			Tracking Procedure		
	400 mc (A)	550 mc (B)	Δf/mc	Step 1 Center	Step 2 Peak	Step 3 Peak
V502 (1st Mixer)	13	22.375	0.0625	C557	L549	C557
V503 (Amplifier)	13	22.375	0.0625	C561	T503	C561
V504, V513 (Doublers)	26	44.750	0.1250	C565	T504	C565
V505, V514 (Doublers)	52	98.500	0.2500	C567	L574	C567
V506 (2nd Mixer)	100	137.500	0.2500	C569	L546	C569
V507 (Amplifier)	100	137.500	0.2500	C572	T505	C572
V508 (Amplifier)	200	255.000	0.5000	C574	T506	C574
V509 (Amplifier)	400	550.000	1.0000	C577	L548	C577

NOTE

Use the following equation for the tracking procedure:

$$\frac{B-A}{550-400} = \frac{F}{150\Delta}$$

EXAMPLE: Stage V502 (1st Mixer) is solved as follows:

$$\frac{22.375-13}{550-400} = \frac{9.375}{150} = 0.0625$$

6-46. ALIGNMENT OF 48-MC INPUT. The alignment of the 48-mc input is accomplished in the following manner:

a. Connect a frequency counter to T507 (figure 6-28) through an isolating probe. Adjust R245 (figure 6-24) until the counter indicates 48 mc.

b. Adjust T507 (figure 6-28) for maximum output as indicated on a vtvm.

c. Repeat step 1.

d. Adjust C210 (figure 6-26) until the electron-ray tube indication "flips" when the TUNE AFC control is approximately in the center of its travel.

e. Repeat step 1.

f. Connect the frequency counter to the reference frequency output at J202 (figure 6-25). Adjust L207 (figure 6-35) to indicate 47.9 mc.

g. Repeat step 1.

h. Adjust R260 (figure 6-25) to indicate 160 volts d-c at J204 (figure 6-25).

NOTE

Recheck overall alignment of f-m unit (paragraph 6-27).

i. Adjust R249 (figure 6-24) to the point where the 48-mc output frequency is least affected by a line voltage swing from 105 to 125 volts.

j. Repeat step 1.

6-47. ADJUSTMENT OF CRYSTAL OSCILLATORS. Refer to tables 6-12 and 6-13 for normal crystal frequencies. The adjustments of the crystal oscillators are made as follows:

a. Place operation selector switch S501 in the XTAL position.

b. Connect a vtvm to pin 1 of V502 and check the units crystal voltage for all positions of the UNITS selector.

c. Adjust T501 for a maximum at the middle of the units crystals frequency range (position 5 of the UNITS selector). The minimum voltage at any one position of the UNITS selector should be 0.5 volts r-f.

d. Check the tens crystal voltage at pin 7 of V502 for all positions of the TENS selector. The minimum voltage should be 2 volts r-f.

e. Connect a frequency counter to SAMPLER JACKS J508 and J509 to determine that the crystal frequencies are operating near normal frequency. Normal frequencies are listed in tables 6-10 and 6-11. Exact frequency adjustments will be made after the r-f and f-m units are reinstalled in the signal generator and the r-f shield is in place.

6-48. ADJUSTMENT OF INTERPOLATION OSCILLATOR (VFO). Refer to figure 6-34. Adjust the interpolation oscillator in the following manner:

a. Set operation selector switch S501 to XTAL + VFO and connect a frequency counter probe to pin 1 of V501.

b. Set C613 (CALIBRATE VFO control) to center position.

c. Set the UNITS selector to 0. Adjust L558 to indicate 3.5000 mc.

d. Set the UNITS selector to 9. Adjust C614 to indicate 4.0625 mc.

e. Adjust T502 for maximum output in the middle of the frequency range (approximately 3.7803). The minimum output at any position of the UNIT selector (positions 1 to 9) should be 1 volt.

f. Repeat steps c and d.

g. The CARRIER MONITOR meter should zero beat for all frequency settings with only slight adjustment of the CALIBRATE VFO control.

6-49. TRACKING OF TUNED STAGES. This procedure involves the adjustment of the tuned stages which are ganged together on the tuning unit shafts. Refer to table 6-11 for the tracking procedure.

6-50. Remove the r-f tuning unit bottom plate, before beginning the adjustment procedure. The capacitor plates should be straight, parallel, and well centered. The plates should be approximately 10^{o} from full mesh with the TENS and UNITS selectors set for 400 mc, and 20^{o} in mesh when set for 550 mc. The total rotation is 150^{o} between 400 and 550 mc.

6-51. Rough adjustment should be made with a vtvm connected at the output of the stage being tune. Fine adjustments should be made with the vtvm probe placed at the output beyond the stage being tuned, preventing capacitive detuning of the stages. The CARRIER MONITOR meter may be used as a tuning indicator for the high frequency side of the tuning unit.

NOTE

The vtvm must be used when tuning the low-frequency side (L574, T504, T503, and L549) because of extreme limiting.

6-52. Track the ends of the frequency bands in the r-f unit, using table 6-9. A grid dip meter should be used to insure that the frequency being tuned is the proper frequency, and not some spurious signal. Lock the coil adjustments when the ends of the bands are in track to prevent them from shifting. Starting with the first stage, maximize the output of each stage of the r-f unit by slightly bending the plates of the ganged capacitor. V508 and V509 are affected by the r-f tuning unit cover. It is necessary, therefore, that these stages, including the low-frequency stages, be peaked to provide optimum tracking with the cover in place.

6-53. REDUCING SPURIOUS F-M AND A-M. The peak adjustments to reduce spurious f-m signals should be made after initial tracking is completed. It may be necessary to replace either or both mixer tubes, V502 or V506. Spurious a-m may be reduced by refinement of the tracking in the final stage, V509.

6-54. OVERALL ALIGNMENT. Perform the overall alignment as follows:

a. Replace the r-f tuning unit bottom plate, r-f shield can, and crystal trimmer access plate.

b. Install the r-f and f-m assembly and support brackets. Replace the signal generator cabinet.

c. Connect the signal generator to its power source and allow one hour for warm-up.

d. Remove the cabinet and access plate and connect a frequency counter to sampler jacks J508 and J509 (figure 6-30).

e. Adjust the output frequency of the tens and units oscillators for each position of the TENS and UNITS

TABLE 6-12

R-F UNIT, CRYSTAL FREQUENCIES
TENS CRYSTALS

TENS Selector Dial Indication	Crystal	Frequency in mc
40	Y501	9.500
41	Y502	10.125
42	Y503	10.750
43	Y504	11.375
44	Y505	12.000
45	Y506	12.625
46	Y507	13.250
47	Y508	13.875
48	Y509	14.500
49	Y510	15.125
50	Y511	15.750
51	Y512	16.375
52	Y513	17.000
53	Y514	17.625
54	Y515	18.250
55	Y516	18.875

selectors. The crystal trimmers and sampler jacks are accessible through holes in the rear of the r-f shield can. The correct frequencies are given in tables 6-12 and 6-13.

f. Replace the access plate and cabinet and allow the signal generator to warm up for at least two hours more.

g. Connect a frequency measuring device to the RF OUTPUT connector.

h. Slide the cabinet to the rear and adjust R245, accessible through the hole in the top right side of the r-f shield can, until the frequency indicated by the measuring device corresponds to the frequency dial setting.

i. Check the output frequency at several points on the frequency dial.

NOTE

Readjust C210 if the electron-ray tube indication cannot be "flipped" with the TUNE AFC control. The r-f shield may be removed for this adjustment, without removing the r-f and f-m assembly, by means of a long shank screwdriver.

TABLE 6-13

R-F UNIT, CRYSTAL FREQUENCIES
UNITS CRYSTALS

UNITS Selector Dial Selection	Crystal	Frequency in mc
0	Y517	3.5000
1	Y518	3.5625
2	Y519	3.6250
3	Y520	3.6875
4	Y521	3.7500
5	Y522	3.8125
6	Y523	3.8750
7	Y524	3.9375
8	Y525	4.0000
9	Y526	4.0625

6-55. CALIBRATION OF CARRIER MONITOR METER. The meter is zeroed and calibrated as follows:

a. Rotate the POWER SET control to its extreme counterclockwise position.

b. Place the ZERO SET control to its center position.

c. Adjust R503 (figure 6-13) until CARRIER MONITOR meter is approximately zeroed.

d. Adjust ZERO SET control until CARRIER MONITOR meter is exactly zeroed.

e. Set selector switch to XTAL position.

f. Adjust POWER SET switch until CARRIER MONITOR meter indicates on red line.

g. Connect a vtvm between pin 7 of V515 and ground and adjust R501 (figure 6-13) for a reading of -0.3 volts d-c.

h. Repeat steps f and g until both requirements are met.

6-56. LUBRICATION.

6-57. No lubrication of the signal generator is required.

6-58. INSPECTION SCHEDULE.

6-59. Table 5-2 is the inspection schedule for the signal generator. There are no further periodic inspections.

6-60. OVERHAUL SCHEDULE.

6-61. The signal generator should be overhauled every six months. Overhaul is performed at depots in accordance with the instructions in the applicable handbook of overhaul instructions.

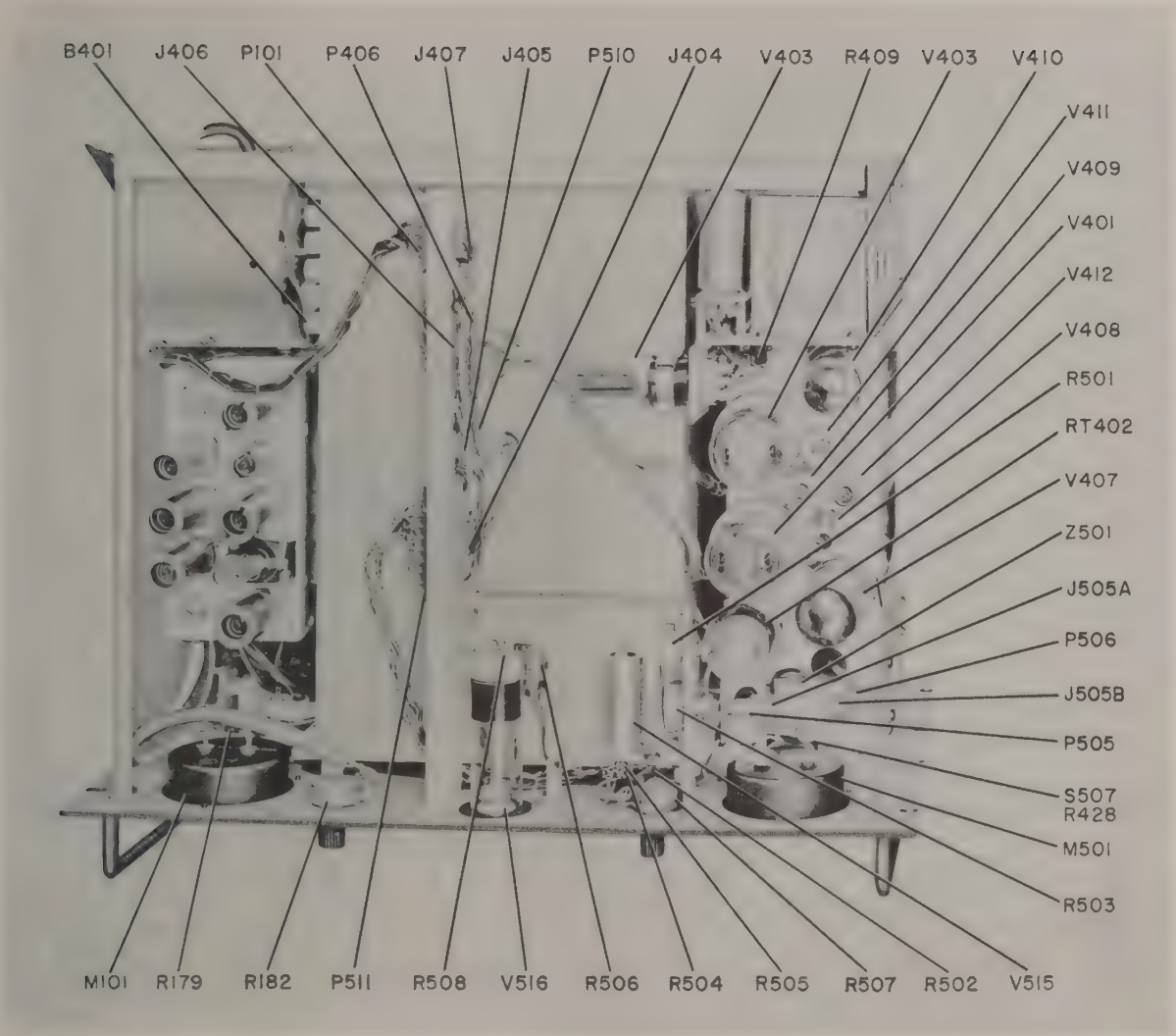


Figure 6-13. Signal Generator, Top View

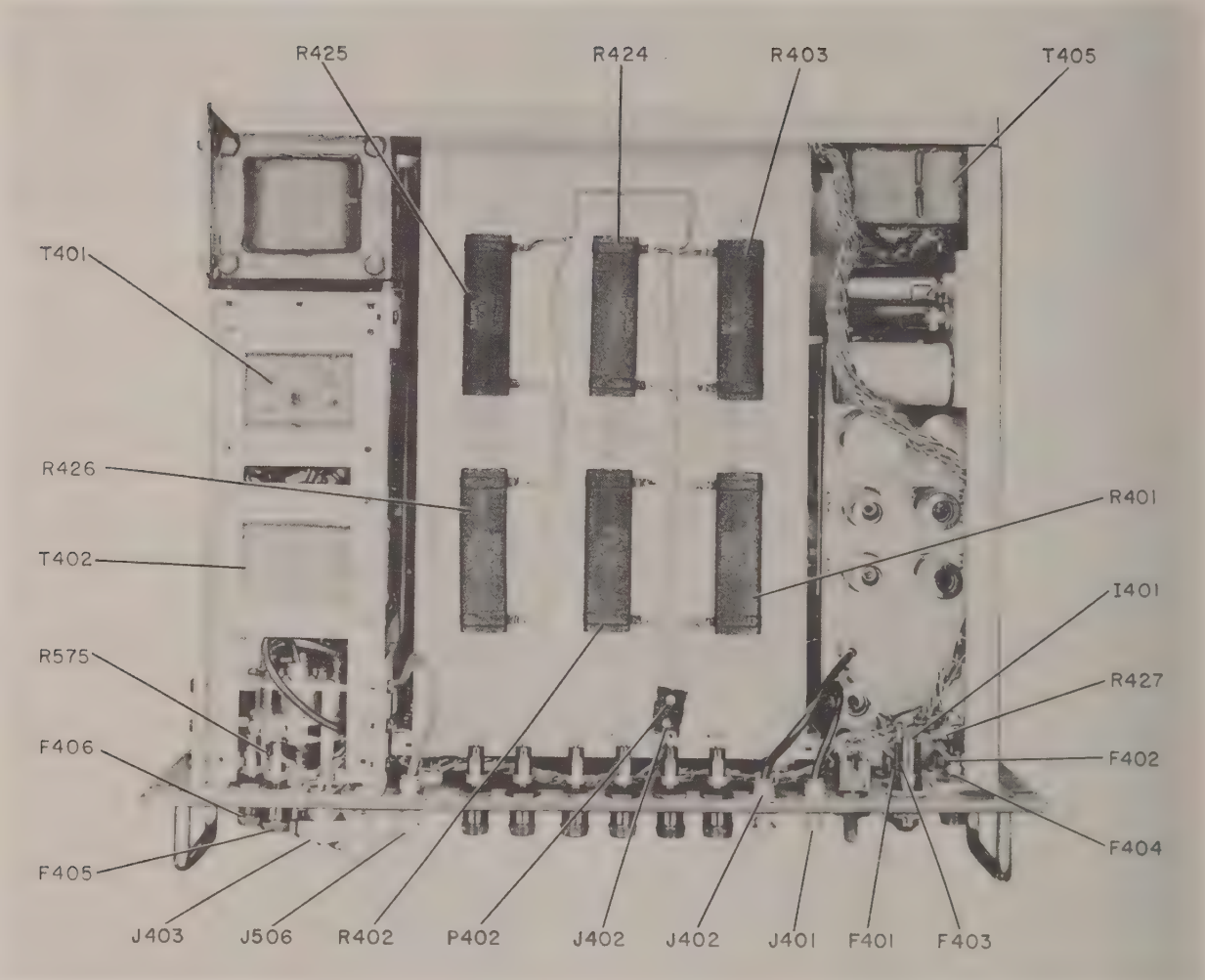


Figure 6-14. Signal Generator, Bottom View

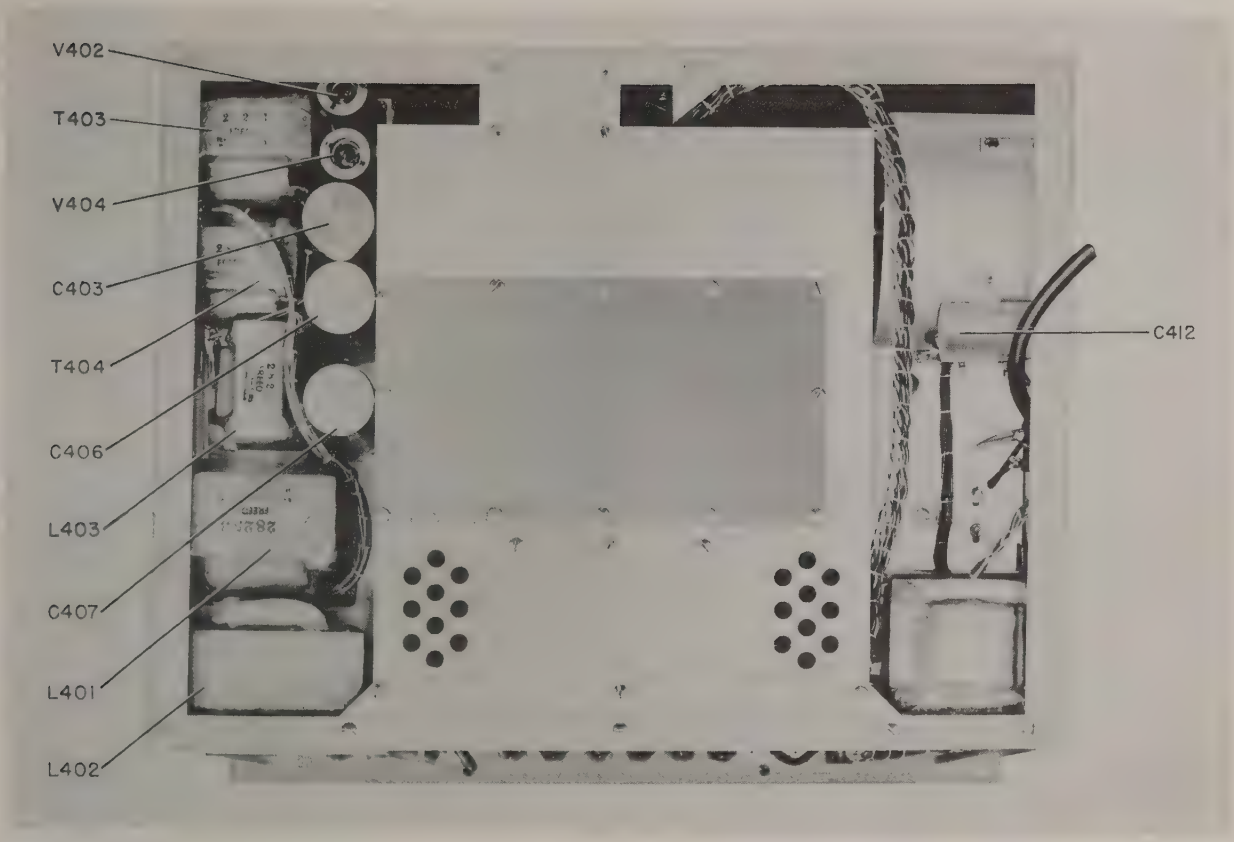


Figure 6-15. Signal Generator, Rear View

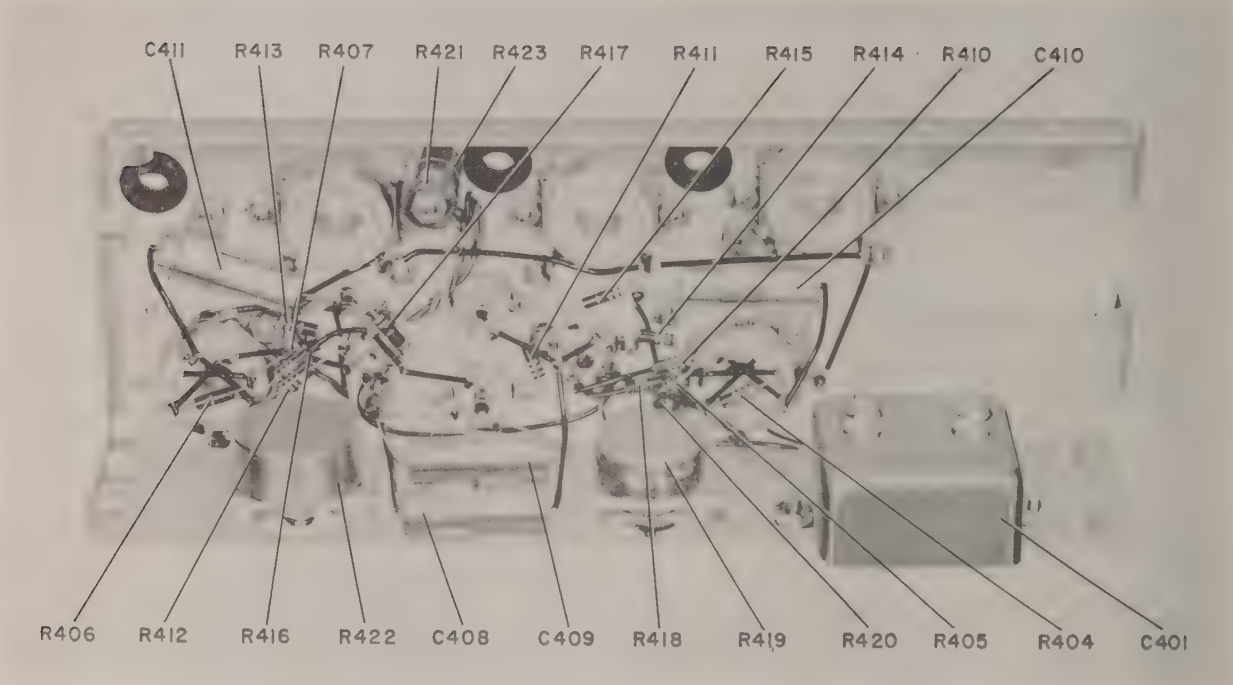


Figure 6-16. Power Supply Tube Shelf, Bottom View

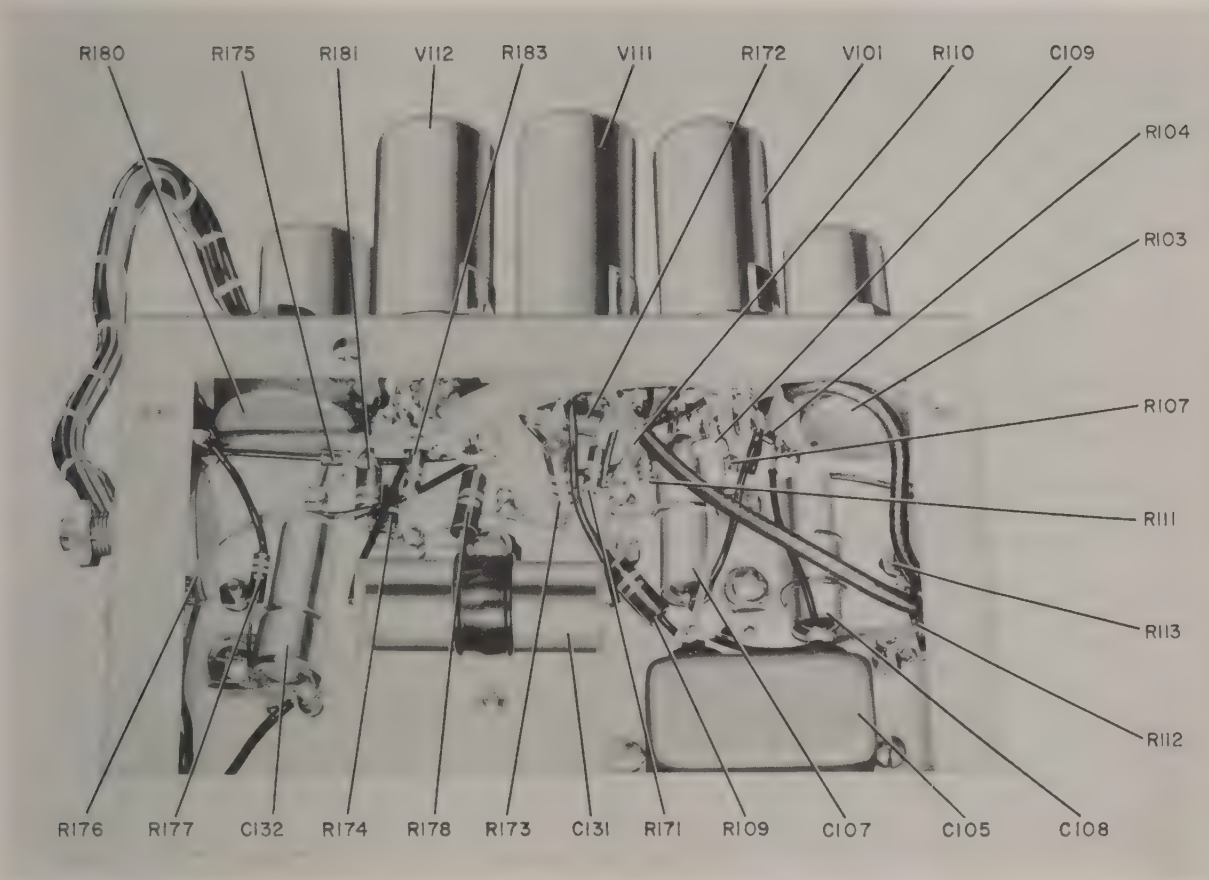


Figure 6-17. Audio Unit, Top Left View

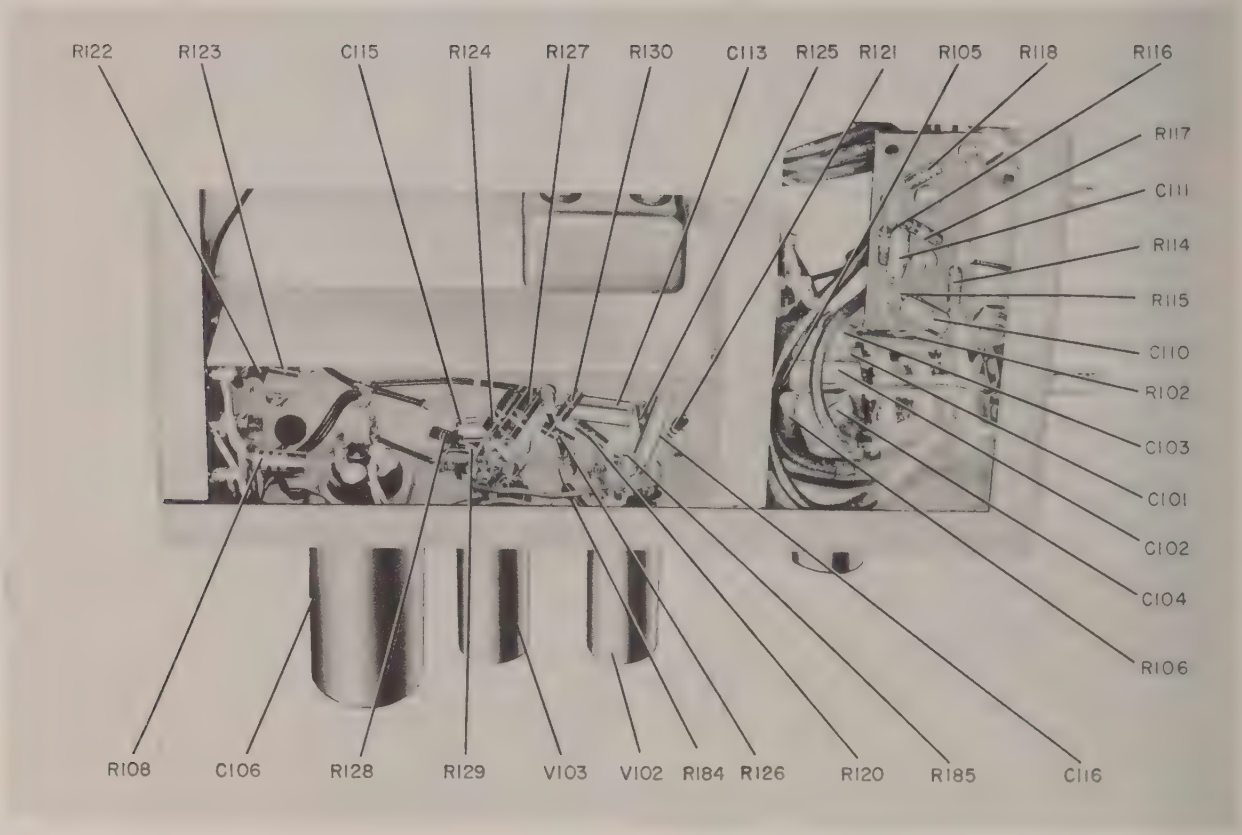


Figure 6-18. Audio Unit, Bottom Left View

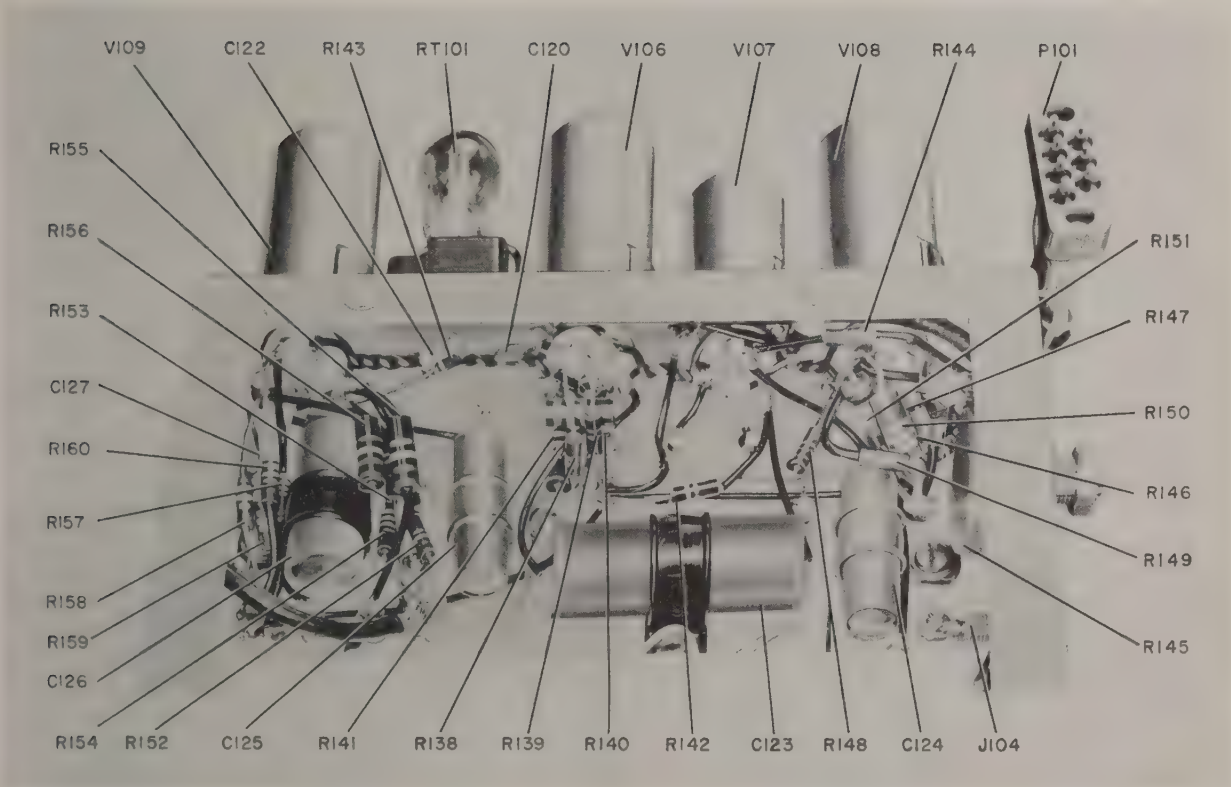


Figure 6-19. Audio Unit, Top Right View

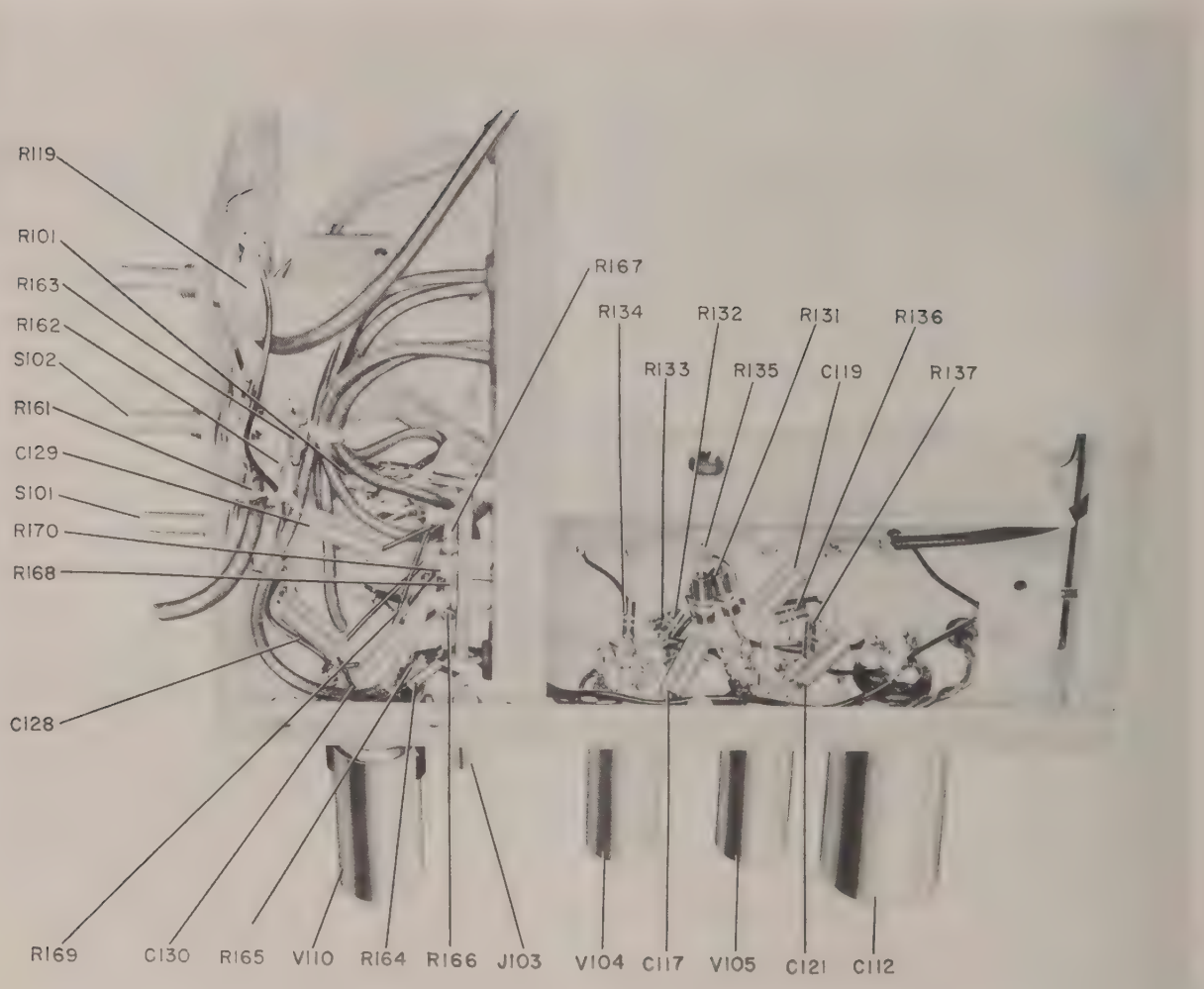


Figure 6-20. Audio Unit, Bottom Right View

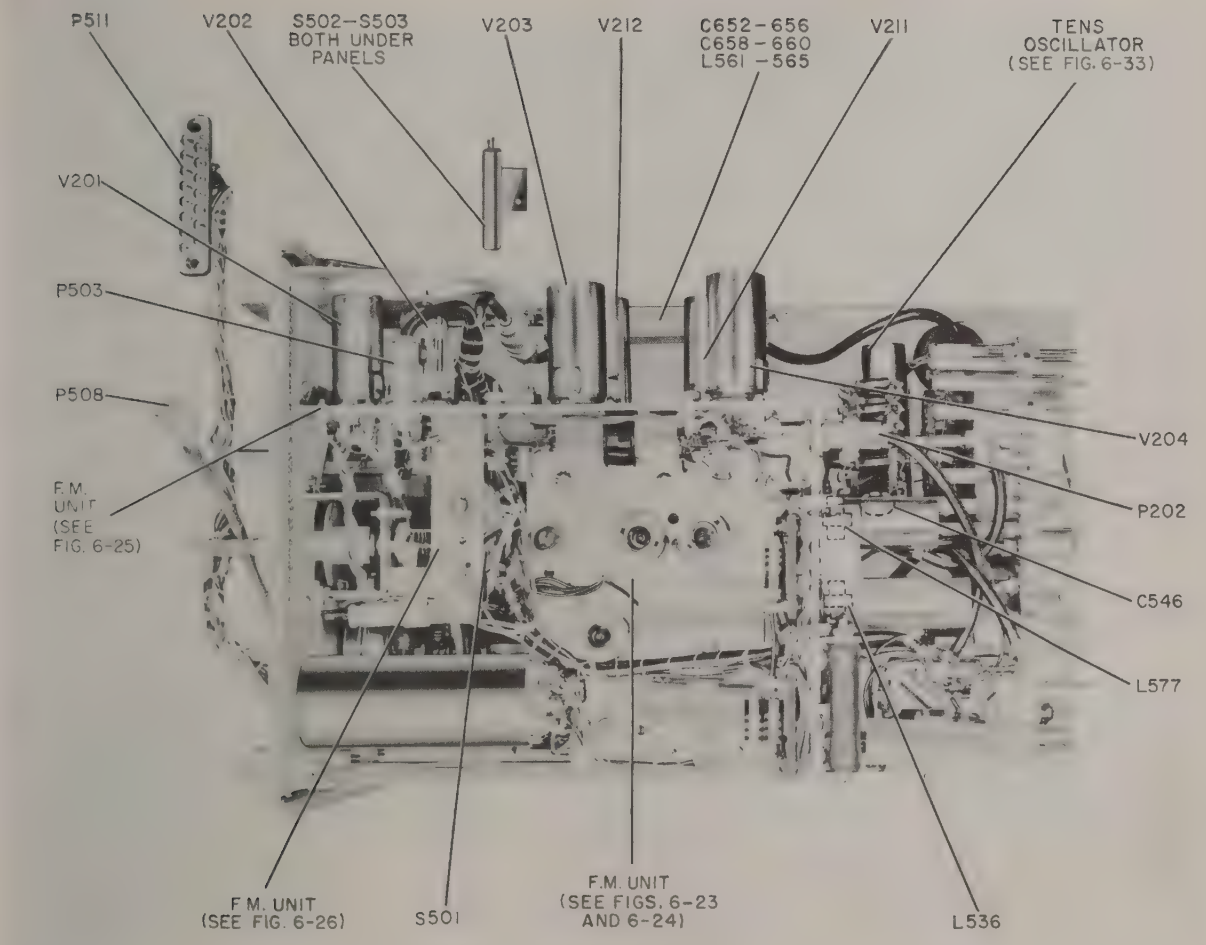


Figure 6-21. R-F and F-M Assembly, Top View

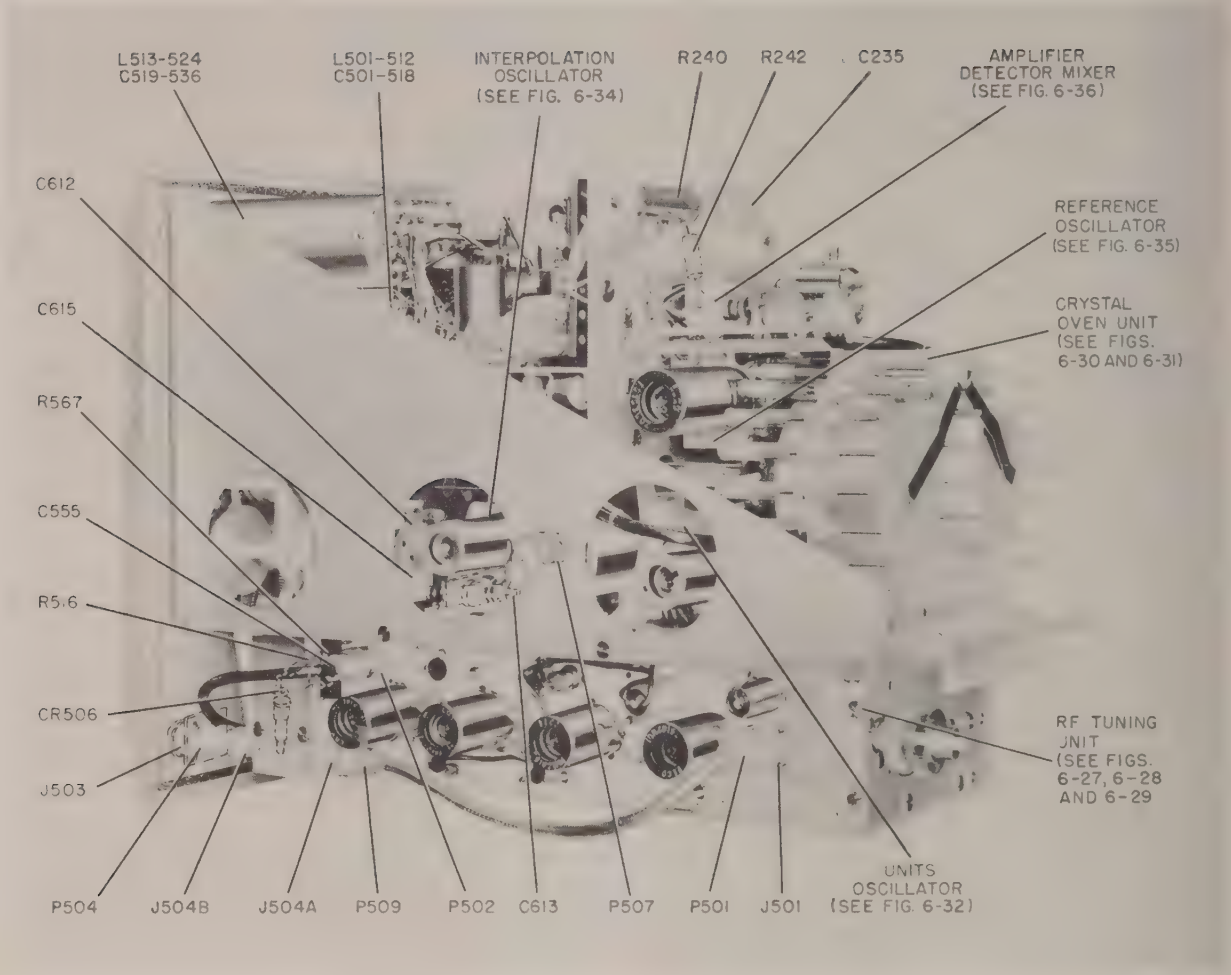


Figure 6-22. R-F and F-M Assembly, Right Side View

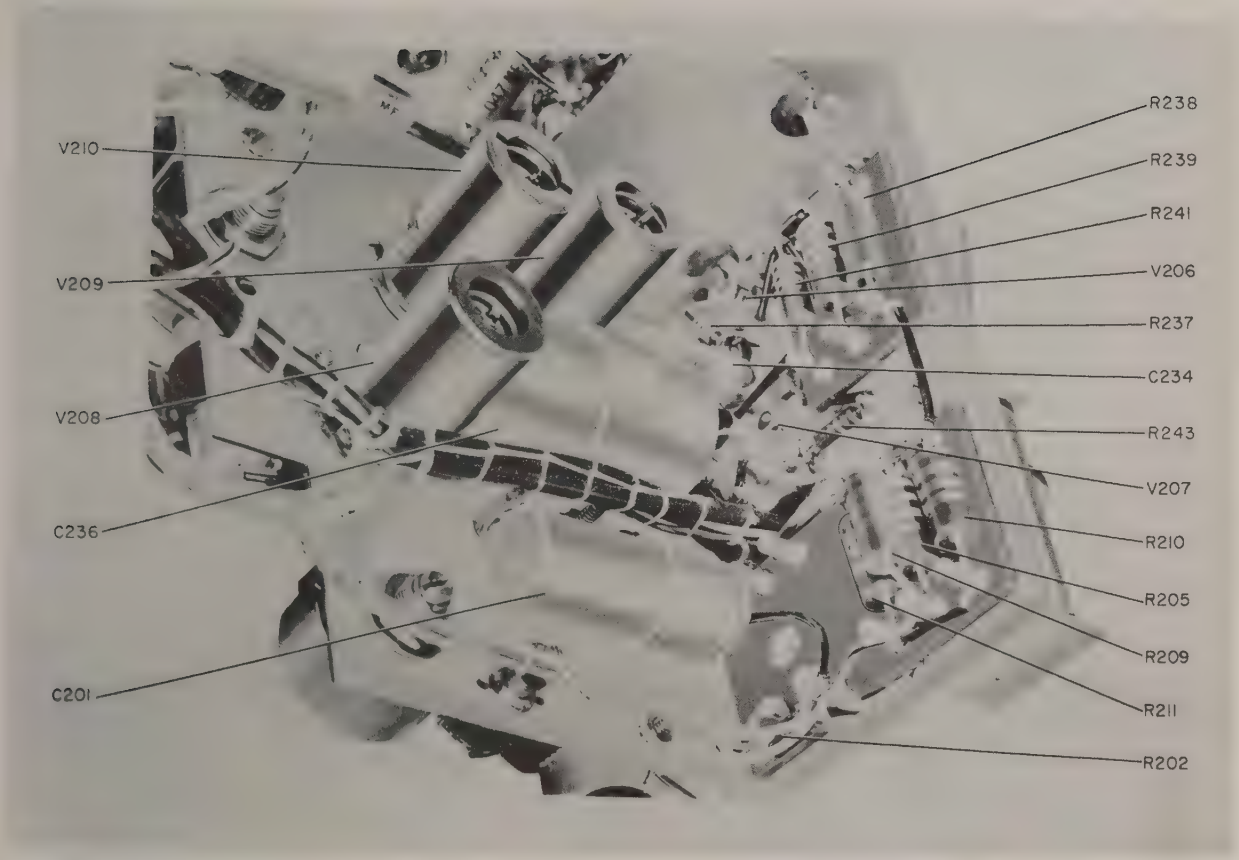


Figure 6-23. F-M Unit, Top View

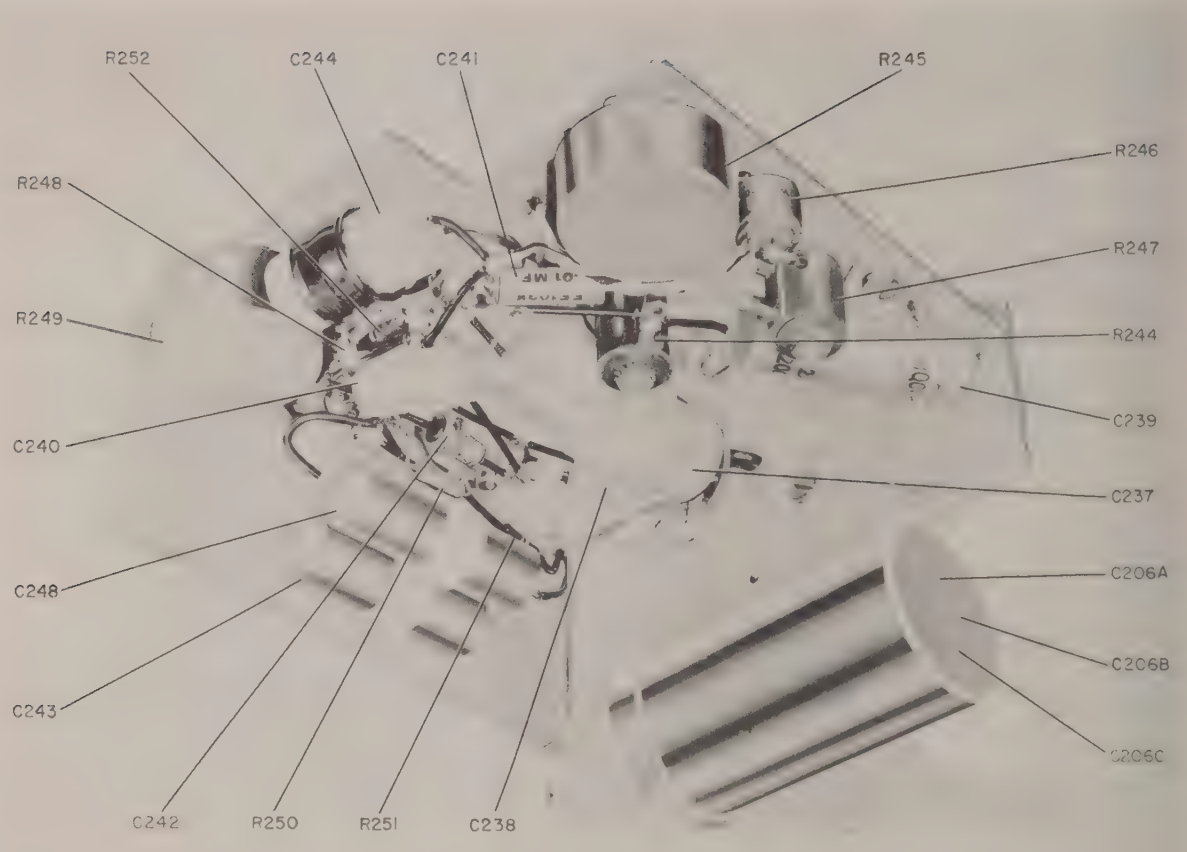


Figure 6-24. F-M Unit, Bottom View

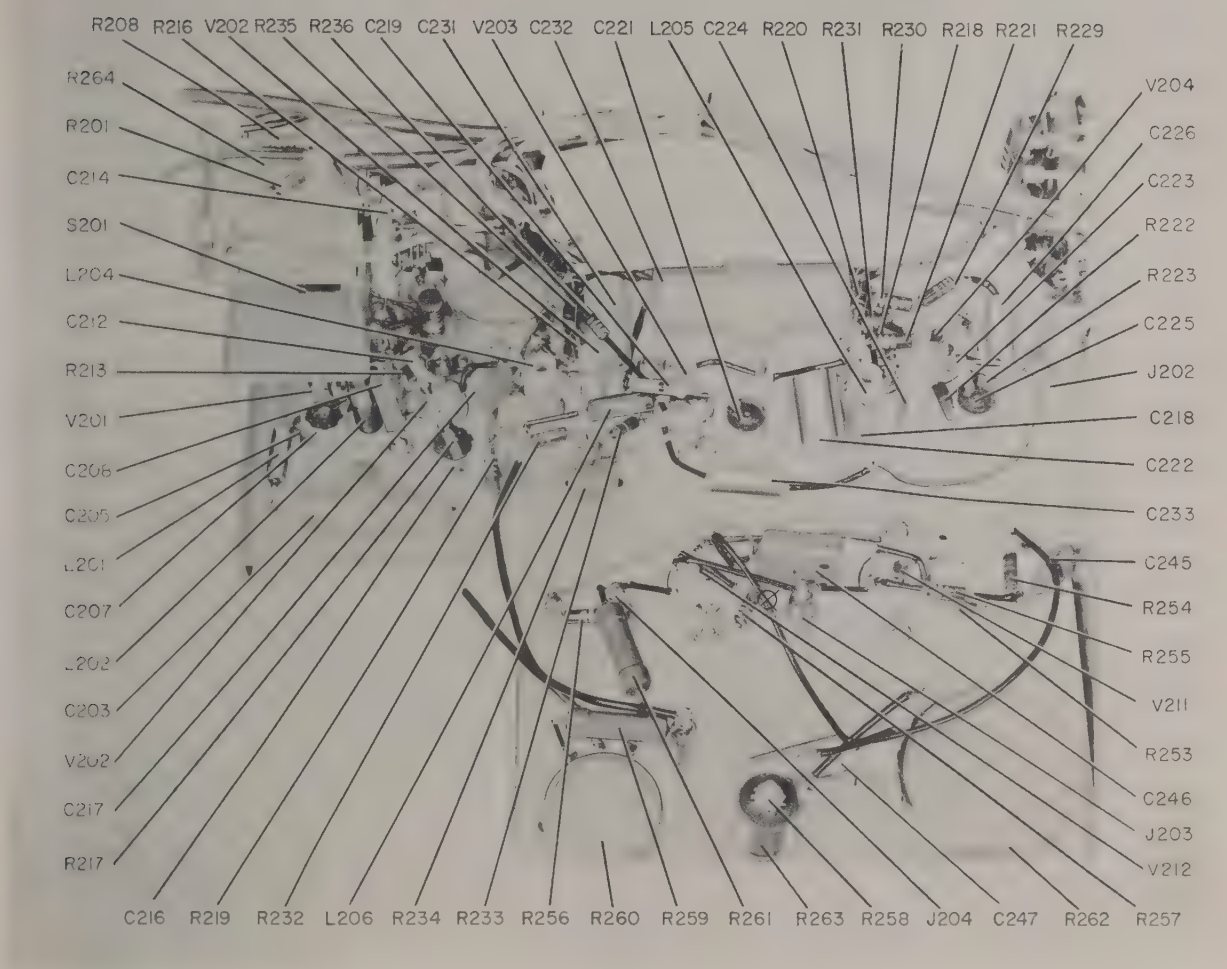


Figure 6-25. F-M Unit, Right Side View

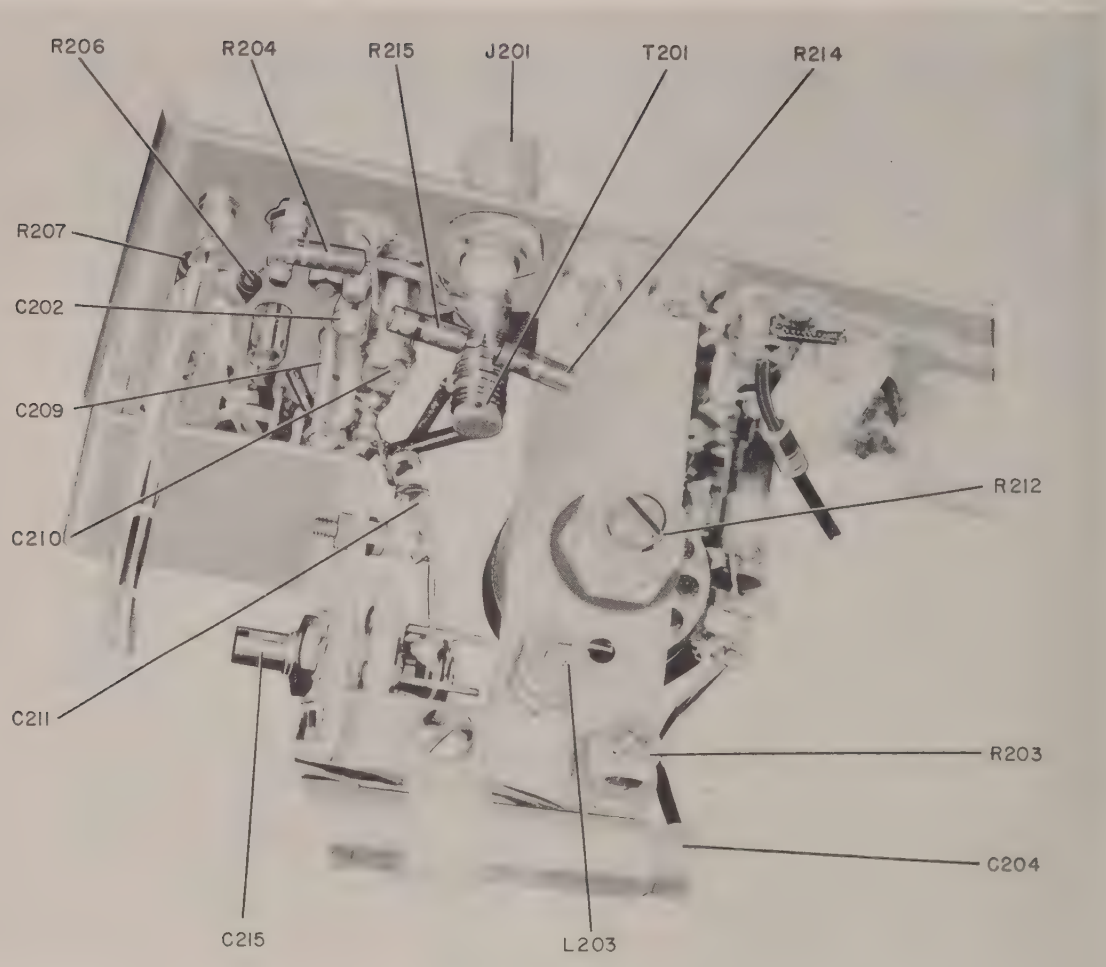


Figure 6-26. F-M Unit, Electrical Bracket Assembly

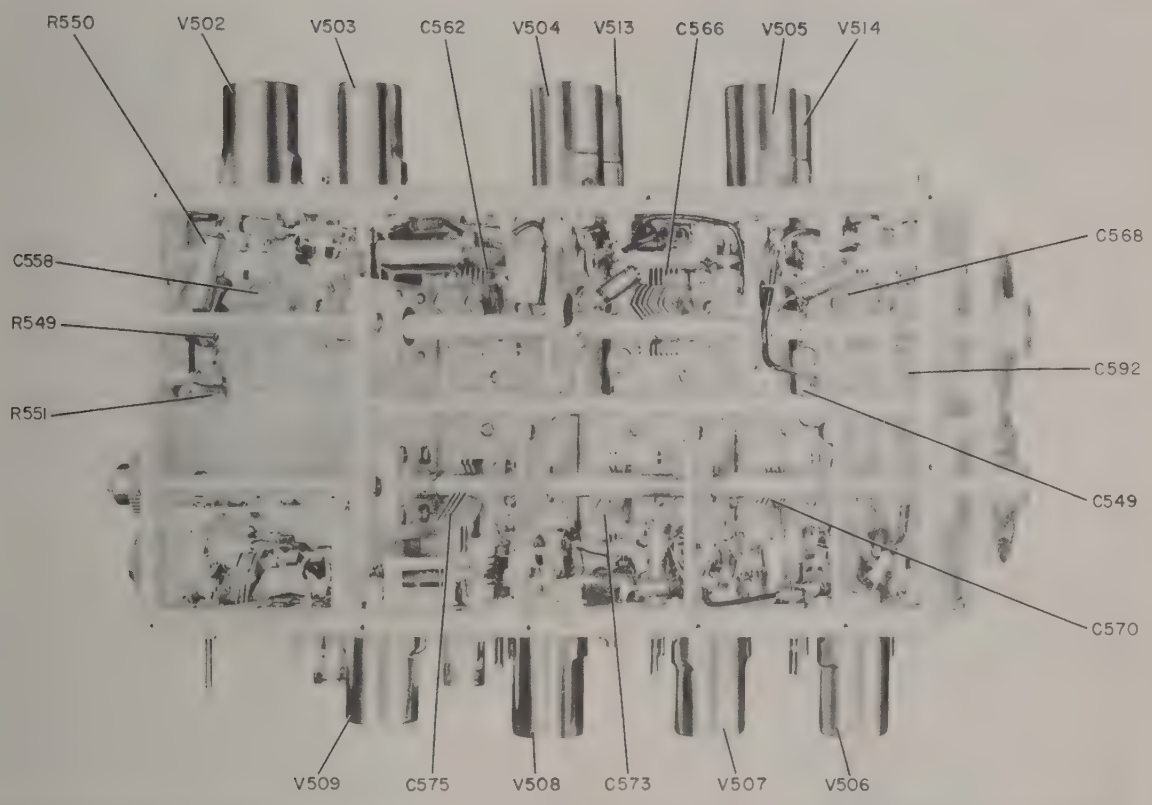


Figure 6-27. R-F Tuning Unit, Cover Plate Removed

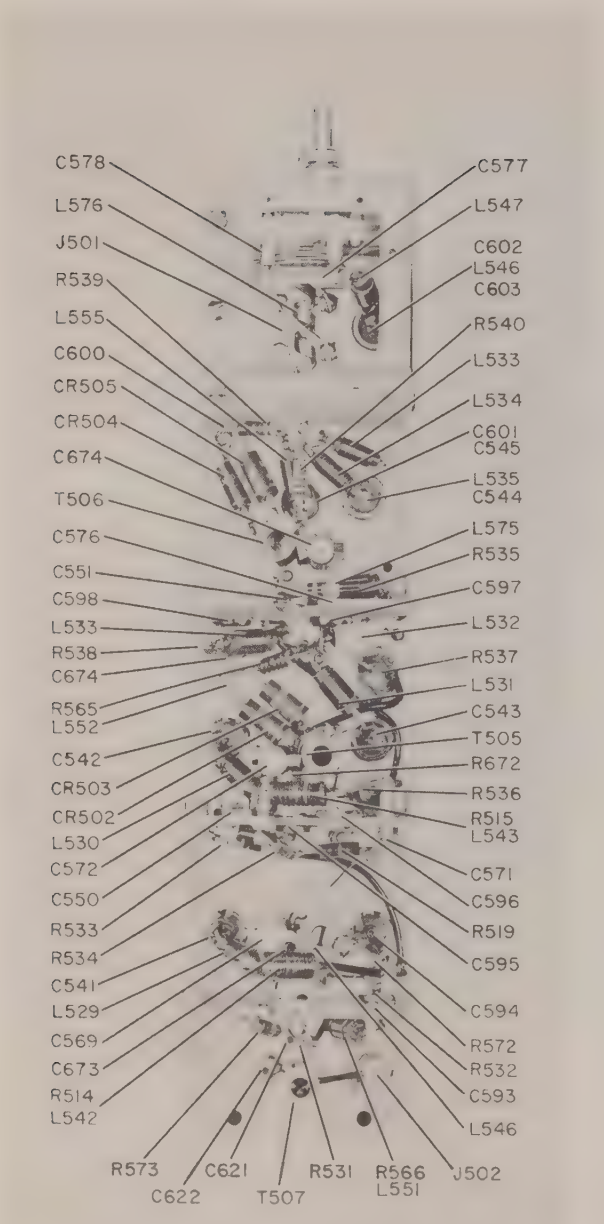


Figure 6-28. R-F Tuning, Tube Chassis, Left Side View

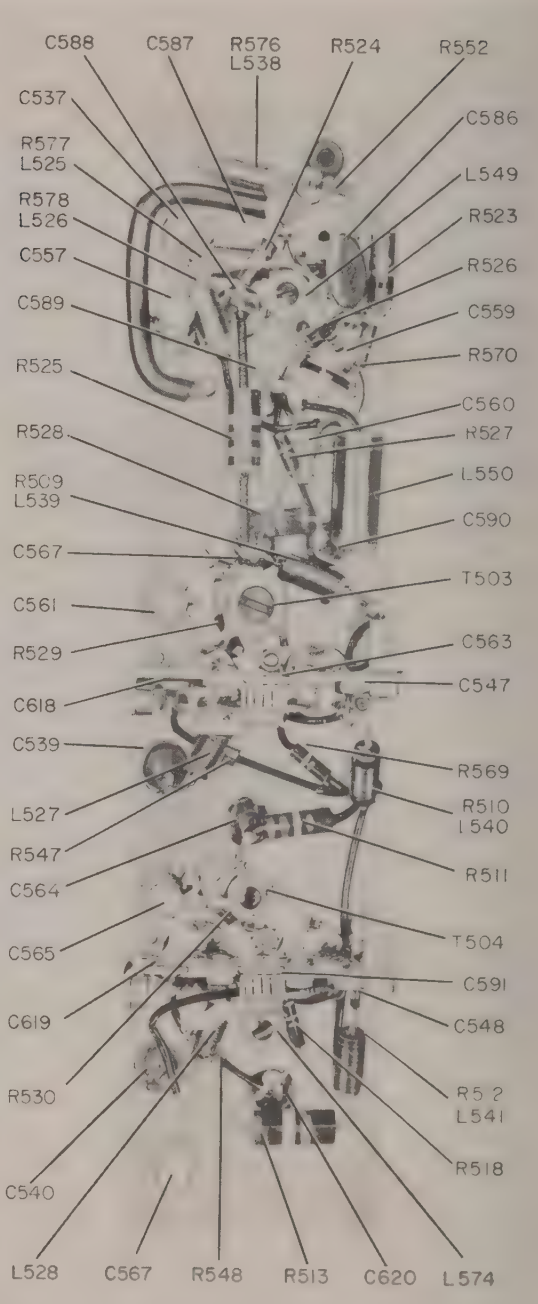


Figure 6-29. R-F Tuning, Tube Chassis, Right Side View

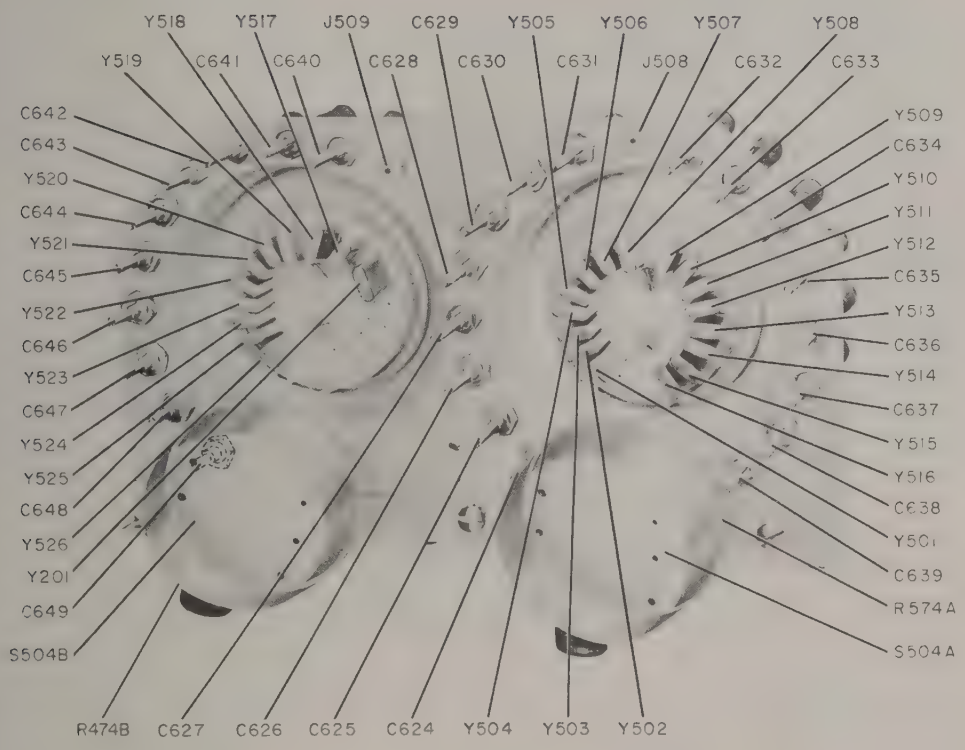


Figure 6-30. Crystal Oven Unit, Top View

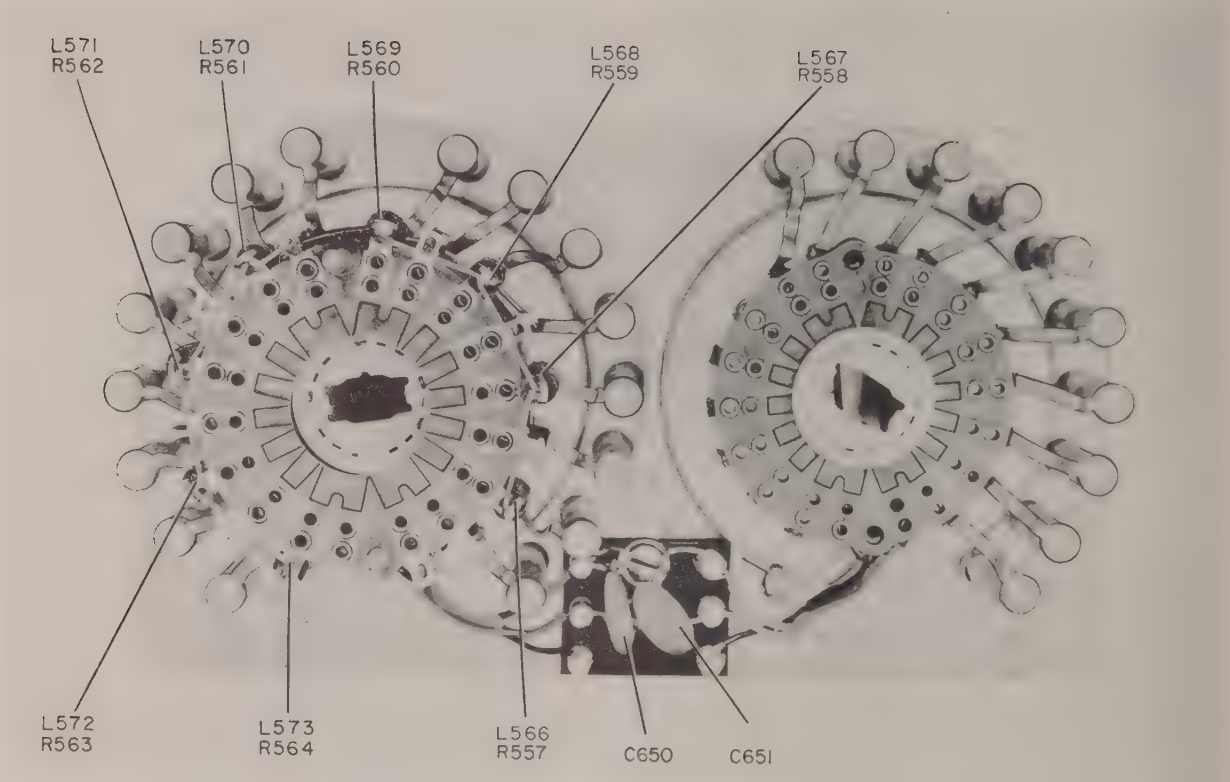


Figure 6-31. Crystal Oven Unit, Bottom View

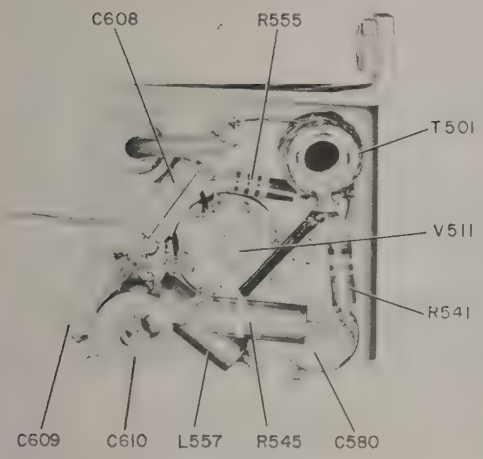


Figure 6-32. Units Oscillator

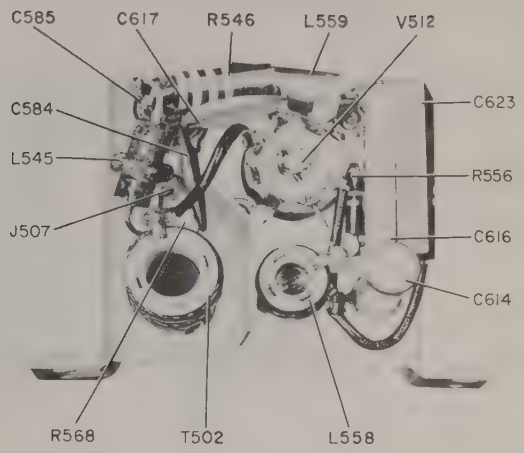


Figure 6-34. Interpolation Oscillator

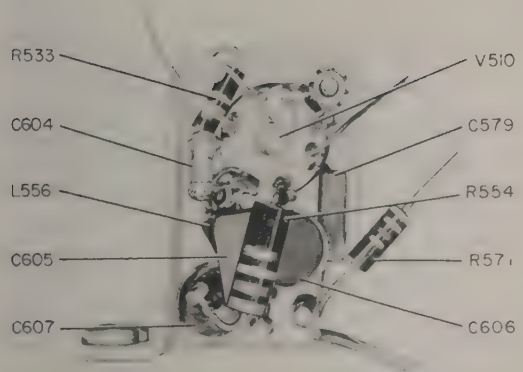


Figure 6-33. Tens Oscillator

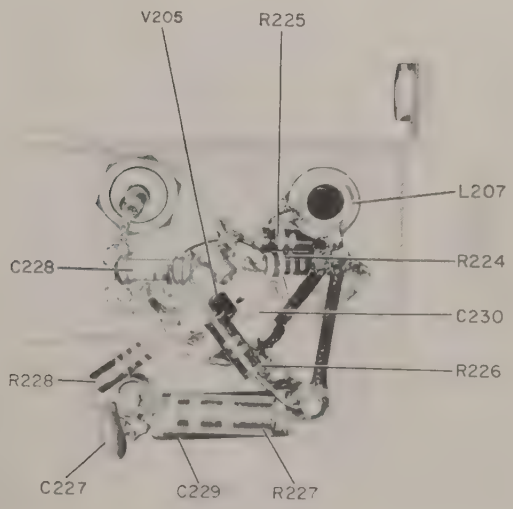


Figure 6-35. Reference Oscillator

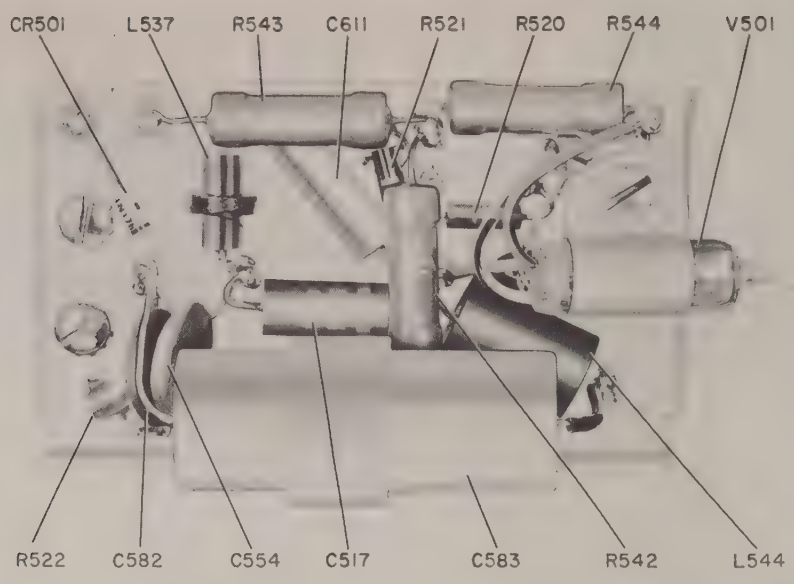


Figure 6-36. Amplifier Detector Mixer

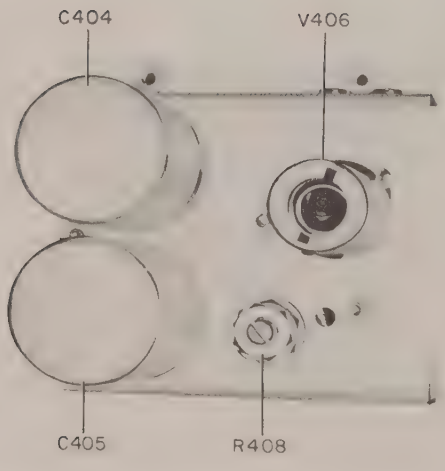


Figure 6-37. Negative Power Supply, Top View

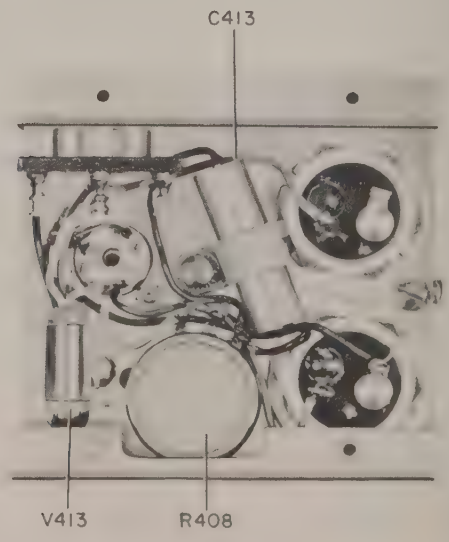


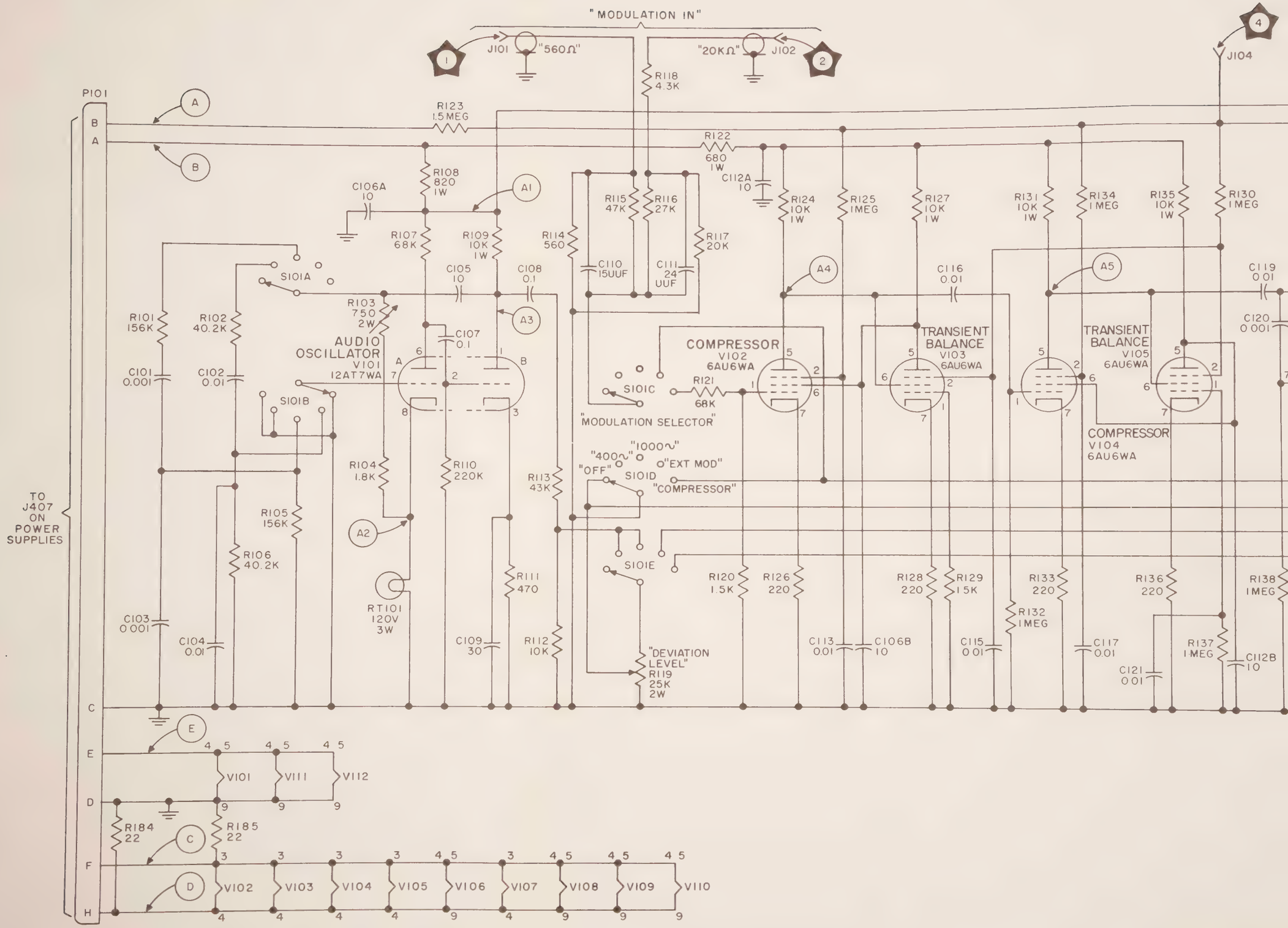
Figure 6-38. Negative Power Supply, Bottom View

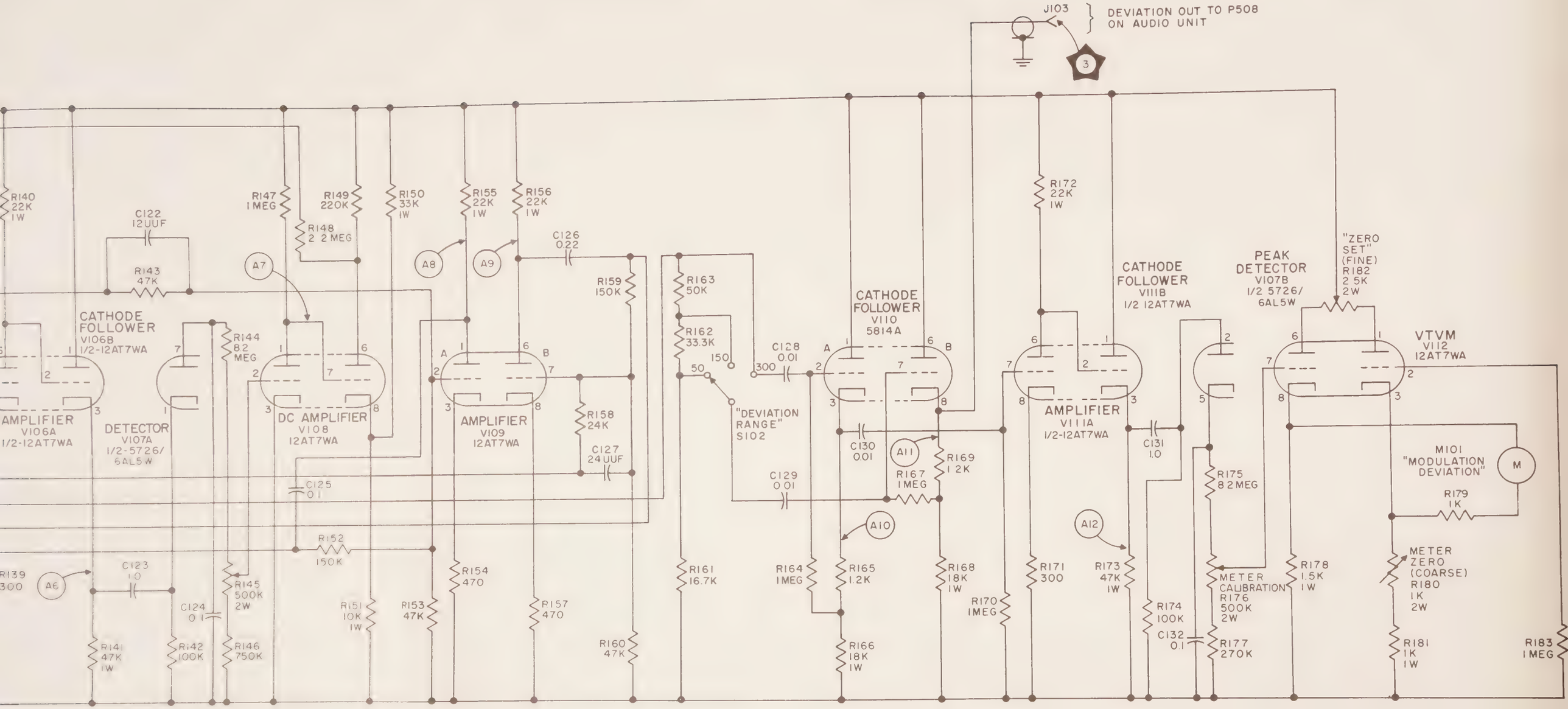
SECTION VII

DIAGRAMS

7-1. EXPLANATORY NOTE.

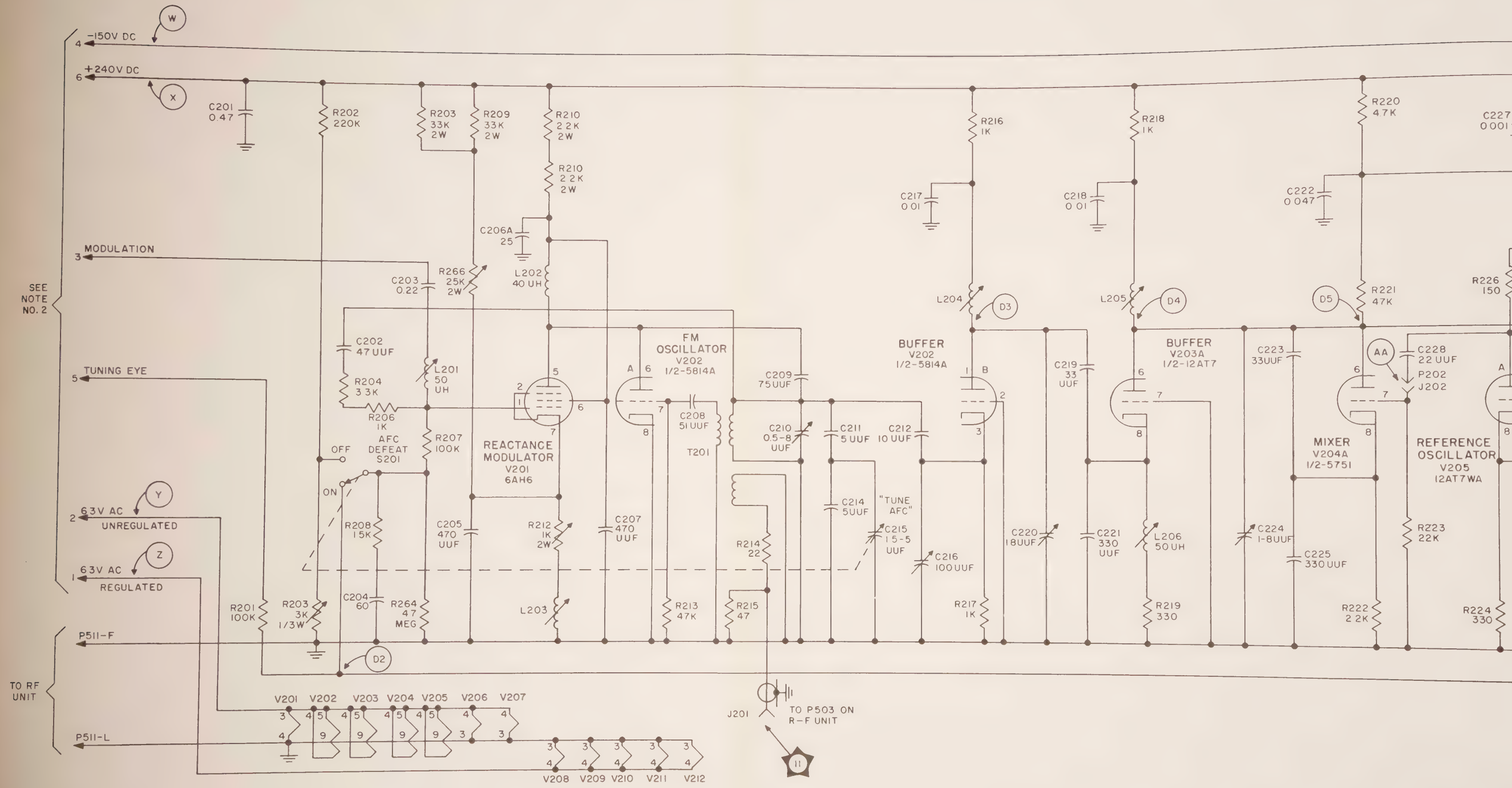
7-2. This section contains the schematic diagrams required to maintain and repair Signal Generator AN/ARM-24. Maintenance personnel should use this section to identify the test points used in the trouble analysis charts in Section VI, and as an aid in trouble-shooting the equipment. The diagrams may also be used as an aid to understanding the theory of operation discussed in Section IV.

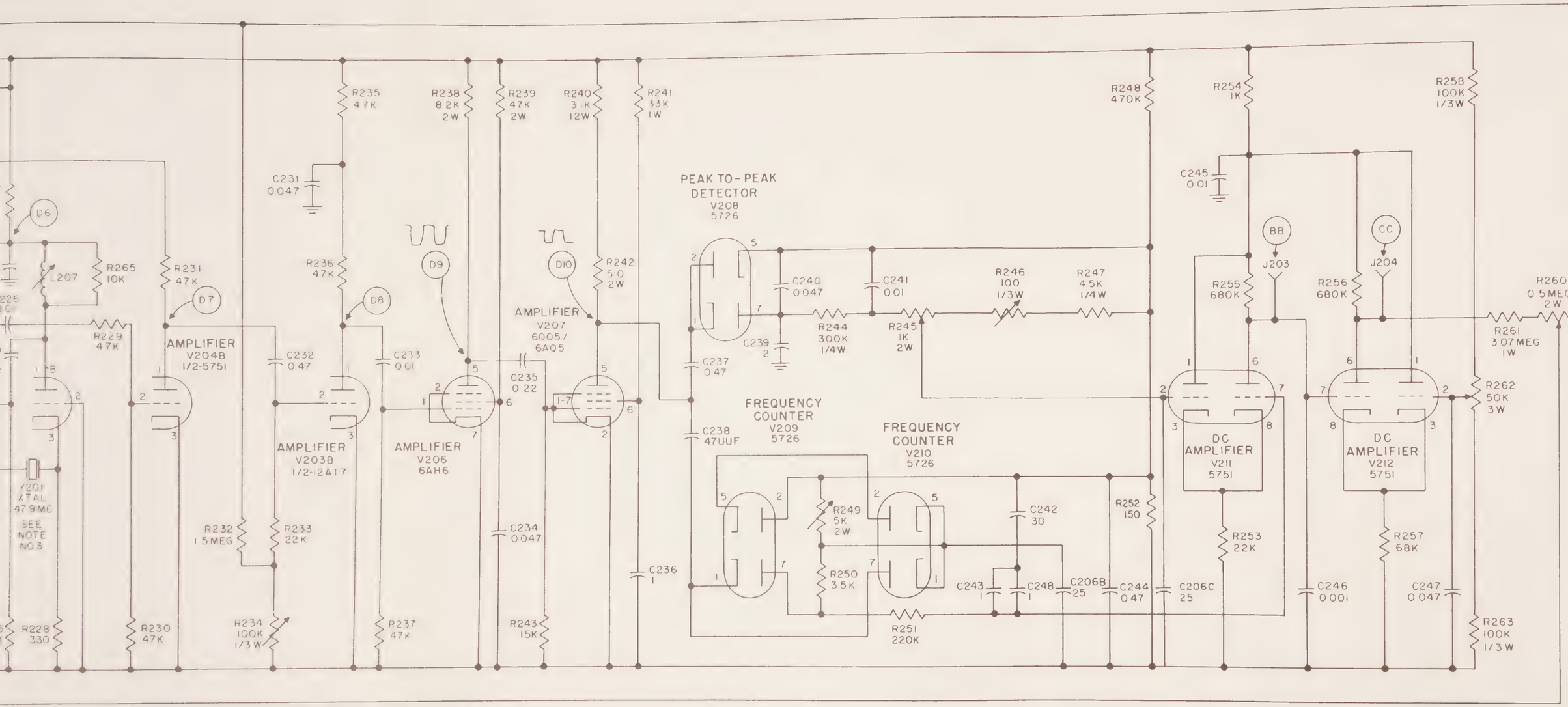

"MODULATION IN"
J101
"560Ω"
"20KΩ"
J102
J104
P101
TO J407 ON POWER SUPPLIES
R118 4.3K
R123 1.5MEG
R122 680 1W
C112A 10
R108 820 1W
C106A 10
R107 68K
R109 10K 1W
R114 560
R115 47K
R116 27K
R117 20K
C110 15UUF
C111 24 UUF
R124 10K 1W
R125 1MEG
R127 10K 1W
R131 10K 1W
R134 1MEG
R135 10K 1W
R130 1MEG
C105 10
C108 0.1
C116 0.01
C119 0.01
C120 0.001
S101A
R101 156K
R102 40.2K
C101 0.001
C102 0.01
R103 750 2W
AUDIO OSCILLATOR V101 12AT7WA
C107 0.1
S101B
COMPRESSOR V102 6AU6WA
S101C
R121 68K
"MODULATION SELECTOR"
TRANSIENT BALANCE V103 6AU6WA
TRANSIENT BALANCE V105 6AU6WA
COMPRESSOR V104 6AU6WA
"1000~"
"400~"
"EXT MOD"
"OFF"
S101D
"COMPRESSOR"
R104 1.8K
R110 220K
R113 43K
R105 156K
R106 40.2K
C103 0.001
C104 0.01
RT101 120V 3W
C109 30
R111 470
R112 10K
S101E
"DEVIATION LEVEL" R119 25K 2W
R120 1.5K
R126 220
R128 220
R129 1.5K
R132 1MEG
R133 220
R136 220
R137 1MEG
R138 1MEG
C113 0.01
C106B 10
C115 0.01
C117 0.01
C121 0.01
C112B 10
A1
A2
A3
A4
A5
A
B
C
D
E
F
H
V101
V111
V112
R184 22
R185 22
V102
V103
V104
V105
V106
V107
V108
V109
V110



NOTE:
UNLESS OTHERWISE SPECIFIED
RESISTANCE IS IN OHMS, 1/2 WATT
CAPACITANCE IS IN MICROFARADS

Figure 7-1. Audio Unit, Schematic Diagram


W
4 -150V DC
6 +240V DC
X
C201 0.47
R202 220K
R203 33K 2W
R209 33K 2W
R210 2.2K 2W
R210 2.2K 2W
C206A 25
L202 40 UH
3 MODULATION
SEE NOTE NO. 2
C203 0.22
R266 25K 2W
C202 47 UUF
R204 3.3K
R206 1K
L201 50 UH
5 TUNING EYE
OFF
AFC DEFEAT S201
ON
R207 100K
REACTANCE MODULATOR V201 6AH6
FM OSCILLATOR V202 1/2-5814A
C208 51 UUF
T201
C209 75 UUF
C210 0.5-8 UUF
C211 5 UUF
C212 10 UUF
R216 1K
C217 0.01
L204
D3
BUFFER V202 1/2-5814A
C219 33 UUF
R218 1K
C218 0.01
L205
D4
BUFFER V203A 1/2-12AT7
R220 4.7K
C222 0.047
D5
R221 47K
C223 33UUF
AA
C228 22 UUF
P202
J202
MIXER V204A 1/2-5751
REFERENCE OSCILLATOR V205 12AT7WA
C224 1-8UUF
C225 330 UUF
R223 22K
R222 2.2K
R224 330
C220 18UUF
C221 330 UUF
L206 50 UH
R219 330
C214 5UUF
"TUNE AFC"
C215 15-5 UUF
C216 100 UUF
R217 1K
R214 22
R213 47K
R215 47
Y
2 6.3V AC UNREGULATED
Z
1 6.3V AC REGULATED
R201 100K
R203 3K 1/3W
C204 60
R264 47 MEG
L203
R208 15K
C205 470 UUF
R212 1K 2W
C207 470 UUF
D2
P511-F
P511-L
TO RF UNIT
V201 V202 V203 V204 V205 V206 V207
V208 V209 V210 V211 V212
J201
TO P503 ON R-F UNIT
11



NOTES:

1 UNLESS OTHERWISE SPECIFIED! RESISTANCE IS IN OHMS—1/2 WATT CAPACITANCE IS IN MICROFARADS

2 CORRESPOND TO SIMILARLY NUMBERED LEADS SHOWN CONNECTED TO RF FILTER ON RF UNIT SCHEMATIC.

3 Y201 XTAL IS LOCATED IN UNITS OVEN.

Figure 7-2. F-M Unit, Schematic Diagram

TO J404 ON POWER SUPPLIES

P511

DEVIATION IN, TO J103 ON AUDIO UNIT

P508

F L S J P R K N H M E A D B C

COAX CABLE

S502

S503

C501 330 L501 C507 330 L502 C513 330

C502 330 L503 C508 330 L504 C514 330

C503 330 L505 C509 330 L506 C515 330

C504 330 L507 C510 330 L508 C516 330

C505 330 L509 C511 330 L510 C517 330

C506 330 L511 C512 330 L512 C518 330

C519 15 L513 C525 15 L514 C531 15

C520 330 L515 C526 330 L516 C532 330

C521 330 L517 C527 330 L518 C533 330

C522 330 L519 C528 330 L520 C534 330

C523 330 L521 C529 330 L522 C535 330

C524 330 L523 C530 330 L524 C536 330

RF FILTER

V510 V511 V512 V501

R574A HEATER C650 0.01UF S504A

6.3V AC REGULATED

6.3V AC UNREGULATED

MODULATION

-150V DC

TUNING EYE

+240V DC

SEE NOTE NO.2

Y501 C624 1-12

Y502 C625 1-12

Y503 C626 1-12

Y504 C627 1-12

Y505 C628 1-12

Y506 C629 1-12

Y507 C630 1-12

Y508 C631 1-12

Y509 C632 1-12

Y510 C633 1-12

Y511 C634 1-12

Y512 C635 1-12

Y513 C636 1-12

Y514 C637 1-12

Y515 C638 1-12

Y516 C639 1-12

S506B "TENS"

R574B HEATER C651 0.01UF S504B

Y517 C640 1-12

Y518 C641 1-12

Y519 C642 1-12

Y520 C643 1-12

Y521 C644 1-12

Y522 C645 1-12

Y523 C646 1-12

Y524 C647 1-12

Y525 C648 1-12

Y526 C649 1-12

S505 "UNITS"

R557 10K 1W L577 C546 0.01UF

L566

R558 10K, 1W L567

R559 10K, 1W L568

R560 10K, 1W L569

L570 R561 10K 1W

L571 R562 10K, 1W

L572 R563 10K, 1W

L573 R564 10K, 1W

S506A

SAMPLER JACK J508

R571 4.7K

C579 24

XTAL- XTAL+ VFO- VFO S501

R543 16.61 1W

C611 0.01UF

R516 470K C555 0.01UF

R567 150K

L536

L537

R517 10K 1W C554 0.001UF

TENS OSCILLATOR V510 6AU6WA

C604 15 R553 68K L556 C605 100 UUF

R554 82K 1W

R542 66.9 1W

C606 0.001UF

C607 0.001UF

SAMPLER JACK J509

C580 0.001 UF T501 R541 10K

AMPLIFIER DETECTOR V501 5718

CR501 R520 100 R521 10 C582 0.01 UF C583 1UF R522 10K

L544

R544 16.61 1W

UNITS OSCILLATOR V511 6AU6WA

C608 51 L557 C609 150 R555 68K

R545 82K 1W

C610 0.001 UF

C612 47

"CALIBRATE VFO" C613 15-5 C614 1-12 C615 3-50

L558 R556 10K

INTERPOLA OSCILLAT V512 6AH6

J507 P507

L561 L562 L563 L564 L656

C653 470 C656 470 C658 470 C652 75 C654 0.001UF C655 470 C659 470 C660 470

NOTES.
1. UNLESS OTHERWISE SPECIFIED: RESISTANCE IS IN OHMS - 1/2 WATT CAPACITANCE IS IN MICROMICROFARADS, INDUCTANCE IS IN MICROHENRIES.
2. NUMBERED LEADS CORRESPOND TO SIMILARLY NUMBERED LEADS SHOWN CONNECTED TO FILTER BLOCK ON FM UNIT SCHEMATIC.
3. SWITCH S501 SHOWN IN "XTAL" POSITION.

Figure 7-3. R-F Unit, Schematic Diagram

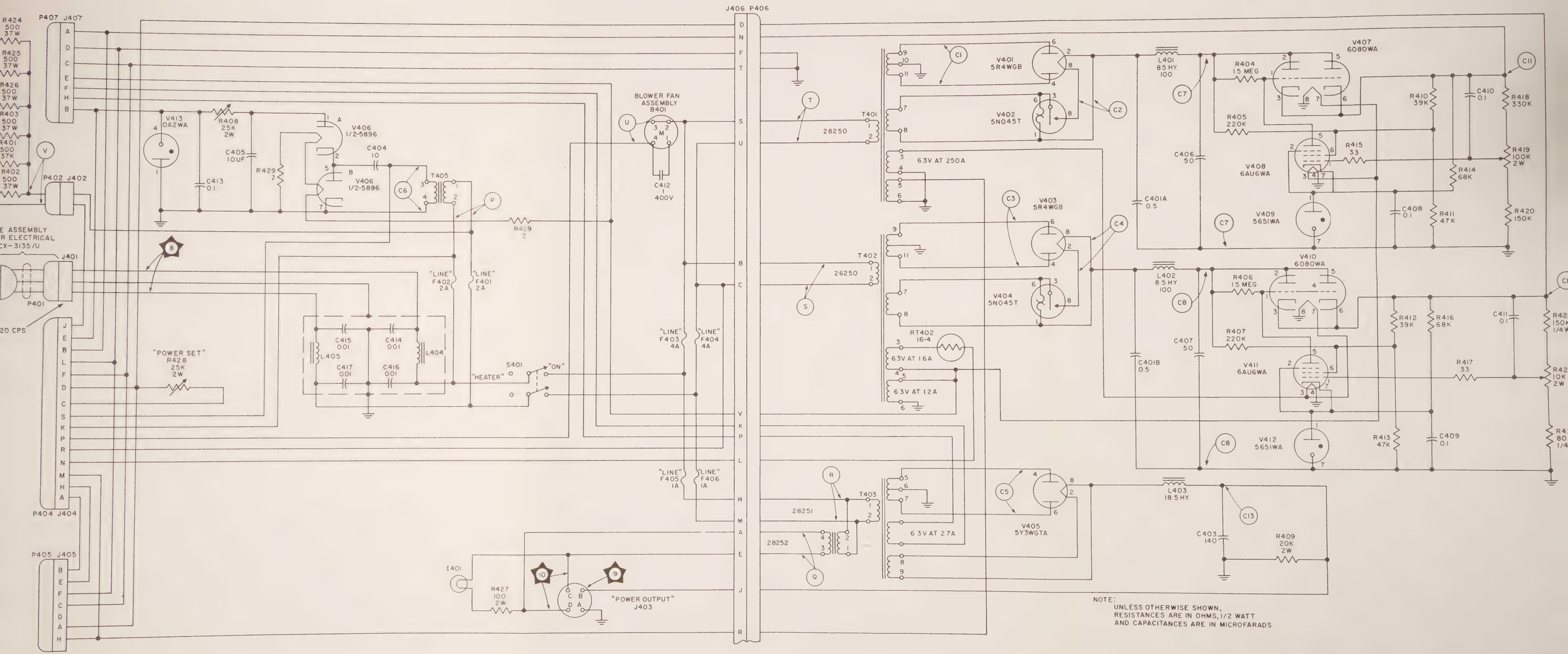


Figure 7-4. Power Supplies, Schematic Diagram

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AUDIO UNIT

Reference Designation	Value	Description	BRC Part No.
C101	1000μμf	Cap. Fixed Mica ±2%	83005-1
C102	10,000μμf	Cap. Fixed Mica ±2% 300 WVDC	83005-13
C103	1000μμf	Cap. Fixed Mica ±2%	83005-1
C104	10,000μμf	Cap. Fixed Mica ±2% 300 WVDC	83005-13
C105	10μf	Cap. Fixed Electrolytic -10% +250% 300V	82405-6
C106	10-10μf	Cap. Fixed Electrolytic -10% +250% 300V	82405-4
C107,108	0.10μf	Cap. Fixed Paper ±10% 400V	82410-2
C109	30μf	Cap. Fixed Electrolytic -15% +50% 6V	82411-1
C110	15μμf	Cap. Fixed Ceramic ±2% 500V	83000-14
C111	24μμf	Cap. Fixed Mica ±5% 300 WVDC	83005-11
C112	10-10μf	Cap. Fixed Electrolytic -10% +250% 300V	82405-4
C113-119	0.010μf	Cap. Fixed Paper ±10% 400V	82410-1
C120	1000μμf	Cap. Fixed Ceramic -20% +100% 500 WVDC	82407-2
C121	0.010μf	Cap. Fixed Paper ±10% 400V	82410-1
C122	12μμf	Cap. Fixed ±2% 500 WVDC	83000-12
C123	1.0μf	Cap. Fixed Paper ±10% 200V	82410-3
C124,125	0.10μf	Cap. Fixed Paper ±10% 400V	82410-2
C126	0.22μf	Cap. Fixed Paper ±10% 400V	82410-6
C127	24μμf	Cap. Fixed Mica ±5% 300 WVDC	83005-11
C128-130	0.010μf	Cap. Fixed Paper ±10% 400V	82410-1
C131	1.0μf	Cap. Fixed Paper ±10% 200V	82410-3

Reference Designation	Value	Description	BRC Part No.
C132	0.10μf	Cap. Fixed Paper ±10% 400V	82410-2
J101,102		Jack, BNC	89065
J103		Jack, BNC	303430
J104		Jack, Tip Green	301970
M101		Meter, Modulation	301951
P101		Connector Plug	304815
R101	156kΩ	Res. Fixed Film ±1% 1/2W	80582-5
R102	40.2kΩ	Res. Fixed Film ±1% 1/2W	80582-9
R103	750Ω	Res. Var. ±10% 2W	81068-9
R104	1.8kΩ	Res. Fixed Comp. ±5% 1/2W	80022-47
R105	156kΩ	Res. Fixed Film ±1% 1/2W	80582-5
R106	40.2kΩ	Res. Fixed Film ±1% 1/2W	80582-9
R107	68kΩ	Res. Fixed Comp. ±5% 1/2W	80022-13
R108	820Ω	Res. Fixed Comp. ±5% 1W	80023-22
R109	10kΩ	Res. Fixed Comp. ±5% 1W	80023-17
R110	220kΩ	Res. Fixed Comp. ±5% 1/2W	80022-16
R111	470Ω	Res. Fixed Comp. ±5% 1/2W	80022-4
R112	10kΩ	Res. Fixed Comp. ±5% 1/2W	80022-9
R113	43kΩ	Res. Fixed Comp. ±5% 1/2W	80022-56
R114	560Ω	Res. Fixed Comp. ±5% 1/2W	80022-57
R115	47kΩ	Res. Fixed Comp. ±5% 1/2W	80022-12
R116	27kΩ	Res. Fixed Comp. ±5% 1/2W	80022-33
R117	20kΩ	Res. Fixed Comp. ±5% 1/2W	80022-48
R118	4.3kΩ	Res. Fixed Comp. ±5% 1/2W	80022-55
R119	25kΩ	Res. Var. ±10% 2W	81070
R120	1.5kΩ	Res. Fixed Comp. ±5% 1/2W	80022-32

Reference Designation	Value	Description	BRC Part No.
R121	68kΩ	Res. Fixed Comp. ±5% 1/2W	80022-13
R122	680Ω	Res. Fixed Comp. ±5% 1W	80023-26
R123	1.5 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-39
R124	10kΩ	Res. Fixed Comp. ±5% 1W	80023-17
R125	1 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-35
R126	220Ω	Res. Fixed Comp. ±5% 1/2W	80022-3
R127	10kΩ	Res. Fixed Comp. ±5% 1W	80023-17
R128	220Ω	Res. Fixed Comp. ±5% 1/2W	80022-3
R129	1.5kΩ	Res. Fixed Comp. ±5% 1/2W	80022-32
R130	1 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-35
R131	10kΩ	Res. Fixed Comp. ±5% 1/2W	80023-17
R132	1 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-35
R133	220Ω	Res. Fixed Comp. ±5% 1/2W	80022-3
R134	1 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-35
R135	10kΩ	Res. Fixed Comp. ±5% 1/2W	80023-17
R136	220Ω	Res. Fixed Comp. ±5% 1/2W	80022-3
R137,138	1 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-35
R139	300Ω	Res. Fixed Comp. ±5% 1/2W	80022-52
R140	22kΩ	Res. Fixed Comp. ±5% 1W	80023-2
R141	47kΩ	Res. Fixed Comp. ±5% 1W	80023-15
R142	100kΩ	Res. Fixed Comp. ±5% 1/2W	80022-14
R143	47kΩ	Res. Fixed Comp. ±5% 1/2W	80022-12
R144	8.2 MegΩ	Res. Fixed Comp. ±5% 1/2W	80022-37
R145	500kΩ	Res. Var. ±10% 2W	81068-8
R146	750kΩ	Res. Fixed Comp. ±5% 1/2W	80022-58
R147	1 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-35

Reference Designation	Value	Description	BRC Part No.
R148	2.2 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-41
R149	220kΩ	Res. Fixed Comp. ±5% 1/2W	80022-16
R150	33kΩ	Res. Fixed Comp. ±5% 1/2W	80023-12
R151	10kΩ	Res. Fixed Comp. ±5% 1/2W	80023-17
R152	150kΩ	Res. Fixed Comp. ±5% 1/2W	80022-22
R153	47kΩ	Res. Fixed Comp. ±5% 1/2W	80022-12
R154	470Ω	Res. Fixed Comp. ±5% 1/2W	80022-4
R155,156	22kΩ	Res. Fixed Comp. ±5% 1W	80023-2
R157	470Ω	Res. Fixed Comp. ±5% 1/2W	80022-4
R158	24kΩ	Res. Fixed Comp. ±5% 1/2W	80022-50
R159	150kΩ	Res. Fixed Comp. ±5% 1/2W	80022-22
R160	47kΩ	Res. Fixed Comp. ±5% 1/2W	80022-12
R161	16.7kΩ	Res. Fixed Film ±1% 1/2W	80582-6
R162	33.3kΩ	Res. Fixed Film ±1% 1/2W	80582-7
R163	50kΩ	Res. Fixed Film ±1% 1/2W	80582-10
R164	1 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-35
R165	1.2kΩ	Res. Fixed Comp. ±5% 1/2W	80022-45
R166	18kΩ	Res. Fixed Comp. ±5% 1W	80023-20
R167	1 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-35
R168	18kΩ	Res. Fixed Comp. ±5% 1W	80023-20
R169	1.2kΩ	Res. Fixed Comp. ±5% 1/2W	80022-45
R170	1 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-35
R171	300Ω	Res. Fixed Comp. ±5% 1/2W	80022-52
R172	22kΩ	Res. Fixed Comp. ±5% 1W	80023-2
R173	47kΩ	Res. Fixed Comp. ±5% 1W	80023-15
R174	100kΩ	Res. Fixed Comp. ±5% 1/2W	80022-14
R175	8.2 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-37

Reference Designation	Value	Description	BRC Part No.
R176	500kΩ	Res. Var. ±10% 2W	81068-8
R177	270kΩ	Res. Fixed Comp. ±5% 1/2W	80022-51
R178	1.5kΩ	Res. Fixed Comp. ±5% 1W	80023-19
R179	1kΩ	Res. Fixed Comp. ±5% 1/2W	80022-5
R180	1kΩ	Res. Var. ±10% 2W	81068-5
R181	1kΩ	Res. Fixed Comp. ±5% 1W	80023-16
R182	2.5kΩ	Res. Var. ±10% 2W	81069
R183	1 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-35
R184,185	22Ω	Res. Fixed Comp. ±5% 1/2W	80022-49
RT101	3W,120V	Lamp, Incandescent	90907
S101		Switch, Rotary	305062
S102		Switch, Rotary	304791
V101		Electron Tube, 12AT7WA	91308-8
V102-105		Electron Tube, 6AU6WA	91308-10
V106		Electron Tube, 12AT7WA	91308-8
V107		Electron Tube, 5726/6AL5W	91308-5
V108,109		Electron Tube, 12AT7WA	91308-8
V110		Electron Tube, 5814A	91308-2
V111,112		Electron Tube, 12AT7WA	91308-8

FM UNIT

C201	0.47μf	Cap. Fixed Paper ±10% 400V	82410-9
C202	47μμf	Cap. Fixed Ceramic ±1% 500 WVDC	83000-16
C203	0.22μf	Cap. Fixed Paper ±10% 100V	82410-5
C204	60μf	Cap. Fixed Electrolytic -15% +50% 50V	83107
C205	470μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-1

Reference Designation	Value	Description	BRC Part No.
C206	25-25-25μf	Cap. Fixed Electrolytic -10% +250% 250V	82405-5
C207	470μμf	Cap. Fixed Mica ±10% 300WVDC	82409-4
C208	51μμf	Cap. Fixed Mica ±2% 300WVDC	83005-15
C209	75μμf	Cap. Fixed Ceramic ±2%	83000-17
C210	0.5-8μμf	Cap. Var. Glass Dielectric	84047
C211	5μμf	Cap. Fixed Ceramic ±0.25μμf 500 WVDC	83000-10
C212	10μμf	Cap. Fixed Ceramic ±0.5μμf 500 WVDC	83000-11
C214	5μμf	Cap. Fixed Ceramic ±0.25μμf 500 WVDC	83000-10
C215	1.5-5μμf	Cap. Var. Air Dielectric Peak Voltage 1250V	304215
C216	100μμf	Cap. Fixed Mica ±5% 300 WVDC	82409-2
C217, 218	10,000μμf	Cap. Fixed Ceramic +100% -20% 500 WVDC	82407-1
C219	33μμf	Cap. Fixed Ceramic ±1% 500 WVDC	83000-15
C220	1-8μμf	Cap. Var. Glass Dielectric Breakdown Voltage 500V	84089
C221	330μμf	Cap. Fixed Mica ±5% 300 WVDC	82409-3
C222	0.047μf	Cap. Fixed Paper ±10% 400V	82410-7
C223	47μμf	Cap. Fixed Ceramic ±1% 500 WVDC	83000-16
C224	1-8μμf	Cap. Var. Breakdown Voltage 500V	84089
C225	330μμf	Cap. Fixed Mica ±5% 300 WVDC	82409-3
C226	0.010μf	Cap. Fixed Paper ±10% 400V	82410-1
C227	1000μμf	Cap. Fixed Ceramic +100% -20% 500 WVDC	82407-2
C228	22μμf	Cap. Fixed Ceramic ±2% 500 WVDC	83000-13
C229	0.010μf	Cap. Fixed Paper ±10% 400V	82410-1
C230	47μμf	Cap. Fixed Ceramic ±1% 500 WVDC	83000-16

Reference Designation	Value	Description	BRC Part No.
C231	0.047μf	Cap. Fixed Paper ±10% 400V	82410-7
C232	0.47μf	Cap. Fixed Paper ±10% 400V	82410-9
C233	0.010μf	Cap. Fixed Paper ±10% 400V	82410-1
C234	0.047μf	Cap. Fixed Paper ±10% 400V	82410-7
C235	0.22μf	Cap. Fixed Paper ±10% 400V	82410-6
C236	1μf	Cap. Fixed Paper ±10% 400V	82410-4
C237	0.47μf	Cap. Fixed Paper ±10% 400V	82410-9
C238	47μμf	Cap. Fixed Paper ±1% 500 WVDC	83000-16
C239	2μf	Cap. Fixed Paper ±20% 200V	83106
C240	0.047μf	Cap. Fixed Paper ±10% 400V	82410-7
C241	0.010μf	Cap. Fixed Paper ±10% 400V	82410-1
C242	30μf	Cap. Fixed Electrolytic -15% +50% 6V	82411-1
C243	1μf	Cap. Fixed Plastic ±20% 50 WVDC	83105
C244	0.47μf	Cap. Fixed Paper ±10% 100 WVDC	82410-8
C245	10,000μμf	Cap. Fixed Ceramic +100% -20% 500 WVDC	82407-1
C246	1000μμf	Cap. Fixed Mica ±2%	83005-1
C247	0.047μf	Cap. Fixed Paper ±10% 400V	82410-7
C248	1μf	Cap. Fixed Plastic ±20% 50 WVDC	83105
J201,202		Receptacle BNC	303430
J203		Jack, Tip Black	302226
J204		Jack, Tip Yellow	302227
L201	50μh	Choke, R.F.	305230
L202	40μh	Choke, R.F.	305244
L203		Coil, R.F.	305245
L204,205		Coil, R.F.	305246
L206	50μh	Choke, R.F.	305230

Reference Designation	Value	Description	BRC Part No.
L207		Coil, R.F.	305247
P202		Connector, Plug BNC	94156
P203,204		Connector, Plug BNC	94156
R201	100kΩ	Res. Fixed Comp. ±5% 1/2W	80022-14
R202	220kΩ	Res. Fixed Comp. ±5% 1/2W	80022-16
R203	3kΩ	Res. Var. ±10% 1/3W	81068-3
R204	3.3kΩ	Res. Fixed Comp. ±5% 1/2W	80022-30
R205	33kΩ	Res. Fixed Comp. ±5% 2W	80024-13
R206	1kΩ	Res. Fixed Comp. ±5% 1/2W	80022-5
R207	100kΩ	Res. Fixed Comp. ±5% 1/2W	80022-14
R208	1.5kΩ	Res. Fixed Comp. ±5% 1/2W	80022-32
R209	33kΩ	Res. Fixed Comp. ±5% 2W	80024-13
R210,211	2.2kΩ	Res. Fixed Comp. ±5% 2W	80024-10
R212	1kΩ	Res. Var. ±10% 2W	81033-1
R213	47kΩ	Res. Fixed Comp. ±5% 1/2W	80022-12
R214	22Ω	Res. Fixed Comp. ±5% 1/2W	80022-49
R215	47Ω	Res. Fixed Comp. ±5% 1/2W	80022-65
R216-218	1kΩ	Res. Fixed Comp. ±5% 1/2W	80022-5
R219	330Ω	Res. Fixed Comp. ±5% 1/2W	80022-27
R220	4.7kΩ	Res. Fixed Comp. ±5% 1/2W	80022-7
R221	47kΩ	Res. Fixed Comp. ±5% 1/2W	80022-12
R222	2.2kΩ	Res. Fixed Comp. ±5% 1/2W	80022-6
R223	22kΩ	Res. Fixed Comp. ±5% 1/2W	80022-28
R224	330Ω	Res. Fixed Comp. ±5% 1/2W	80022-27
R225	10kΩ	Res. Fixed Comp. ±5% 1/2W	80022-9
R226	150Ω	Res. Fixed Comp. ±5% 1/2W	80022-46

Reference Designation	Value	Description	BRC Part No.
R227	4.7kΩ	Res. Fixed Comp. ±5% 1W	80023-21
R228	330Ω	Res. Fixed Comp. ±5% 1/2W	80022-27
R229	4.7kΩ	Res. Fixed Comp. ±5% 1/2W	80022-7
R230,231	47kΩ	Res. Fixed Comp. ±5% 1/2W	80022-12
R232	1.5 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-39
R233	22kΩ	Res. Fixed Comp. ±5% 1/2W	80022-28
R234	100kΩ	Res. Var. ±10% 1/3 W	81068-2
R235	4.7kΩ	Res. Fixed Comp. ±5% 1/2W	80022-7
R236,237	47kΩ	Res. Fixed Comp. ±5% 1/2W	80022-12
R238	8.2kΩ	Res. Fixed Comp. ±5% 2W	80024-22
R239	47kΩ	Res. Fixed Comp. ±5% 2W	80024-20
R240	3.1kΩ	Res. Fixed WW 12W	80027-7
R241	33kΩ	Res. Fixed Comp. ±5% 1W	80023-12
R242	510Ω	Res. Fixed Comp. ±5% 2W	80024-21
R243	15kΩ	Res. Fixed Comp. ±5% 1/2W	80022-10
R244	300kΩ	Res. Fixed WW 1/4W	80581-4
R245	1kΩ	Res. Var. ±10% 2W	81033-1
R246	100Ω	Res. Var. ±10% 1/3W	81068-1
R247	4.5kΩ	Res. Fixed WW 1/4W	80581-5
R248	470kΩ	Res. Fixed Comp. ±5% 1/2W	80022-18
R249	5kΩ	Res. Var. ±10% 2W	81033-3
R250	3.5kΩ	Res. Fixed Film ±1% 1/2W	80582-8
R251	220kΩ	Res. Fixed Comp. ±5% 1/2W	80022-16
R252	150kΩ	Res. Fixed Comp. ±5% 1/2W	80022-22
R253	22kΩ	Res. Fixed Comp. ±5% 1/2W	80022-28
R254	1kΩ	Res. Fixed Comp. ±5% 1/2W	80022-5

Reference Designation	Value	Description	BRC Part No.
R255, 256	680kΩ	Res. Fixed Comp. ±5% 1/2W	80022-19
R257	68kΩ	Res. Fixed Comp. ±5% 1/2W	80022-13
R258	100kΩ	Res. Fixed WW 1/3W	80581-3
R259	2.83 Meg Ω	Res. Fixed Film ±1% 1W	80582-1
R260	500kΩ	Res. Var. ±10% 2W	81068-8
R261	3.07 Meg Ω	Res. Fixed Film ±1% 1W	80582-2
R262	50kΩ	Res. Var. ±10% 3W	81099
R263	100kΩ	Res. Fixed WW 1/3W	80581-3
R264	4.7 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-36
R265	10kΩ	Res. Fixed Comp. ±5% 1/2W	80022-9
R266	25kΩ	Res. Var. ±20% 2W	81068-7
S201		Switch, Sensitive	301076
T201		Transformer, R.F.	305248
V201		Electron Tube, 6AH6	91308-4
V202		Electron Tube, 5814A	91308-2
V203		Electron Tube, 12AT7WA	91308-8
V204		Electron Tube, 5751	91308-9
V205		Electron Tube, 12AT7WA	91308-8
V206		Electron Tube, 6AH6	91308-4
V207		Electron Tube, 6005	91308-6
V208-210		Electron Tube, 5726/6AL5W	91308-5
V211-212		Electron Tube, 5751	91308-9
Y201		Quartz Crystal Unit (portion of BTN 304832)	304832

POWER SUPPLY

B401		Motor, AC	304792

Reference Designation	Value	Description	BRC Part No.
C401	0.5-0.5μf	Cap. Fixed Paper ±10% 600V	82408-1
C403	140μf	Cap. Fixed Electrolytic -10% +250% 250V	82405-2
C404,405	10μf	Cap. Fixed Electrolytic -10% +250% 400V	82405-1
C406,407	50μf	Cap. Fixed Electrolytic -10% +250% 450V	82405-3
C408-411	0.10μf	Cap. Fixed Paper ±10% 400V	82410-2
C412	1μf	Cap. Fixed Paper ±10% 400V	82410-4
C413	0.10μf	Cap. Fixed Paper ±10% 400V	82410-2
C414-417	0.010μf	Cap. Fixed Paper ±10% 400V	82410-1
F401,402	2A	Fuse	95033-1
F403,404	4A	Fuse, SB	95026
F405,406	1A	Fuse, SB	95033-2
I401	28V 0.17A	Lamp, Incandescent	90906
J401		Connector, Receptacle	304813
J402		Connector, Jack	304836
J403		Connector, Receptacle	304812
J404		Connector, Receptacle	304818
J405		Connector, Receptacle	304816
J406		Connector, Receptacle	304820
J407		Connector, Receptacle	304816
J408,409		Connector, Receptacle	304821
L401,402	8.5H at 230 MA	Reactor	304075
L403	18.5H at 50MA	Reactor	304076
L404,405		Choke R.F.	305358
P402		Connector, Plug	305249

Reference Designation	Value	Description	BRC Part No.
P406		Connector, Plug	304819
R401-403	500Ω	Res. Fixed WW 37W	80027-6
R404	1.5 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-39
R405	220kΩ	Res. Fixed Comp. ±5% 1/2W	80022-16
R406	1.5 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-39
R407	220kΩ	Res. Fixed Comp. ±5% 1/2W	80022-16
R408	25kΩ	Res. Var. ±20% 2W	81068-7
R409	20kΩ	Res. Fixed Comp. ±5% 2W	80024-19
R410	39kΩ	Res. Fixed Comp. ±5% 1/2W	80022-54
R411	47kΩ	Res. Fixed Comp. ±5% 1/2W	80022-12
R412	39kΩ	Res. Fixed Comp. ±5% 1/2W	80022-54
R413	47kΩ	Res. Fixed Comp. ±5% 1/2W	80022-12
R414	68kΩ	Res. Fixed Comp. ±5% 1/2W	80022-13
R415	33Ω	Res. Fixed Comp. ±5% 1/2W	80022-53
R416	68kΩ	Res. Fixed Comp. ±5% 1/2W	80022-13
R417	33Ω	Res. Fixed Comp. ±5% 1/2W	80022-53
R418	330kΩ	Res. Fixed Comp. ±5% 1/2W	80022-17
R419	100kΩ	Res. Var. ±10% 2W	81068-6
R420	150kΩ	Res. Fixed Comp. ±5% 1/2W	80022-22
R421	150kΩ	Res. Fixed WW ±1% 1/4W	80581-1
R422	10kΩ	Res. Var. ±10% 2W	81033-2
R423	80kΩ	Res. Fixed WW ±1% 1/4W	80581-2
R424-426	500Ω	Res. Fixed WW 37W	80027-6
R427	100Ω	Res. Fixed Comp. ±5% 2W	80024-7
R428	25kΩ	Res. Var. ±10% 2W	81071
R429	2Ω	Res. WW Special	80200
RT402		Current Regulator	91310

Reference Designation	Value	Description	BRC Part No.
S401		Switch Toggle DPDT	88040
T401-402		Transformer, Power Step Down and Step Up	304072
T403		Transformer, Power Step Down and Step Up	304073
T404		Transformer, Power isolation and Step Down	304074
T405		Transformer, Power Isolation	304077
V401		Electron Tube, 5R4WGB	91308-15
V402		Electron Tube, 5N045T	91309
V403		Electron Tube, 5R4WGB	91308-15
V404		Electron Tube, 5N045T	91309
V405		Electron Tube, 5Y3WGTA	91308-11
V406		Electron Tube, 5896	91308-7
V407		Electron Tube, 6080WA	91308-13
V408		Electron Tube, 6AU6WA	91308-10
V409		Electron Tube, 5651WA	91308-12
V410		Electron Tube, 6080WA	91308-13
V411		Electron Tube, 6AU6WA	91308-10
V412		Electron Tube, 5651WA	91308-12
V413		Electron Tube, OA2WA	91308-3

RF UNIT

C501-518	330μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-11
C519	15μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-12
C520-524	330μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-11
C525	15μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-12

Reference Designation	Value	Description	BRC Part No.
C526-530	330μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-11
C531	15μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-12
C532-536	330μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-11
C537-539	1000μμf	Cap. Fixed Mica ±10%	82409-6
C540-544	470μμf	Cap. Fixed Mica ±10%	82409-13
C545	470μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-9
C546	10,000μμf	Cap. Fixed Ceramic +100% -20% 500 WVDC	82407-1
C547	1000μμf	Cap. Fixed Mica ±10%	82409-6
C548-551	470μμf	Cap. Fixed Mica ±10%	82409-13
C554,555	10,000μμf	Cap. Fixed Ceramic +100% -20% 500 WVDC	82407-1
C557	1-12μμf	Cap. Var. Glass	84090
C559	5μμf	Cap. Fixed Ceramic ±0.25μμf 500 WVDC	83000-10
C560	15μμf	Cap. Fixed Ceramic ±2% 500 WVDC	83000-8
C561	1-12μμf	Cap. Var. Glass	84090
C563,564	470μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-4
C565	1-8μμf	Cap. Var. Glass Breakdown Voltage 500V DC	84089
C567	0.3-3μμf	Cap. Var. Glass Breakdown Voltage 500V DC	84088
C569	1-8μμf	Cap. Var. Glass Breakdown Voltage 500V DC	84089
C571	10μμf	Cap. Fixed Ceramic ±0.5μμf 500 WVDC	83000-11
C572	1-8μμf	Cap. Var. Glass Breakdown Voltage 500V DC	84089
C574	0.3-3μμf	Cap. Var. Glass Breakdown Voltage 500V DC	84088
C576	470μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-4
C577	0.3-3μμf	Cap. Var. Glass Breakdown Voltage 500V DC	84088

Reference Designation	Value	Description	BRC Part No.
C580	1000μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-10
C582	10,000μμf	Cap. Fixed Ceramic +100% -20% 500 WVDC	82407-1
C583	1μf	Cap. Fixed Paper ±10% 200V	82410-3
C584	10,000μμf	Cap. Fixed Ceramic +100% -20% 500 WVDC	82407-1
C585	1000μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-10
C586	10,000μμf	Cap. Fixed Ceramic +100% -20% 500 WVDC	82407-1
C587-590	1000μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-5
C591	470μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-4
C592	10μμf	Cap. Fixed Ceramic ±2%	83000-18
C593-598	470μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-4
C600	470μμf	Cap. Fixed Glass ±5% 500 WVDC	82328-1
C601	470μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-4
C602	470μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-9
C603	470μμf	Cap. Fixed Mica ±10%	82409-13
C604	15μμf	Cap. Fixed Ceramic ±2% 500 WVDC	83000-8
C605	100μμf	Cap. Fixed Mica ±2% 300 WVDC	83005-17
C606,607	1000μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-10
C608	51μμf	Cap. Fixed Mica ±2% 300 WVDC	83005-15
C609	150μμf	Cap. Fixed Mica ±2% 300 WVDC	83005-16
C610	1000μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-10
C611	0.010μf	Cap. Fixed Paper ±10% 400V	82410-1
C612	47μμf	Cap. Fixed Mica ±5% 300 WVDC	83005-21
C613	1.5-5μμf	Cap. Var. Air Peak Voltage 1250V	304215
C614	1-12μμf	Cap. Var. Glass	84090
C615	3-50μμf	Cap. Var. Air	304466
C616	680μμf	Cap. Fixed Mica ±5% 500 WVDC	83005-14

Reference Designation	Value	Description	BRC Part No.
C617	10,000μμf	Cap. Fixed Ceramic +100% -20% 500 WVDC	82407-1
C618-620	470μμf	Cap. Fixed Mica ±10% 300 WVDC	82409-4
C621	33μμf	Cap. Fixed Ceramic ±2% 300 WVDC	83000-15
C622	15μμf	Cap. Fixed Ceramic ±2% 500 WVDC	83000-8
C623	680μμf	Cap. Fixed Mica ±5% 500 WVDC	83005-14
C624-649	1-12μμf	Cap. Var. Glass	84090
C650-651	10,000μμf	Cap. Fixed Ceramic +100% -20% 500 WVDC	82407-1
C652	75μμf	Cap. Fixed Mica ±2% 300 WVDC	83005-20
C653	470μμf	Cap. Fixed Mica ±2% 500 WVDC	83005-19
C654	1000μμf	Cap. Fixed Mica ±2%	83005-1
C655	470μμf	Cap. Fixed Mica ±2% 500 WVDC	83005-19
C657	1000μμf	Cap. Fixed Mica ±10%	82409-6
C658,660	470μμf	Cap. Fixed Mica ±2% 500 WVDC	83005-19
C672	5μμf	Cap. Fixed Ceramic ±0.25μμf 500 WVDC	83000-10
C673	10μμf	Cap. Fixed Ceramic ±2%	83000-18
C674	470μμf	Cap. Fixed Glass ±5% 500 WVDC	82328-1
CR501		Crystal Rectifier, 1N126	91094-2
CR502,505		Crystal Rectifier	91007
CR506		Crystal Rectifier, 1N25	91094-1
J501		Connector Receptacle	302353
J502		Connector Receptacle	303430
J503		Connector Receptacle	89065
J504		RF Monitor Housing	304218
J505		Coupler, Attenuator	305226
J506		Connector Receptacle	89065
J507		Connector Receptacle	303430

Reference Designation	Value	Description	BRC Part No.
J508		Jack Tip Blue	305152
J509		Jack Tip Red	305153
J510		Connector, Receptacle	89065
J511		Connector, Receptacle	304815
J512-514		Connector, Receptacle	304833
J515		Connector, Receptacle	89065
L501,502	80μh at 2.5 Mc.	Coil, R.F.	304990
L503-506	80μh at 2.5 Mc.	Coil, R.F.	304987
L507		Coil, R.F.	304991
L508	16μh at 2.5 Mc.	Coil, R.F.	304988
L509, 510	80μh at 2.5 Mc.	Coil, R.F.	304990
L511,512	15μh at 2.5 Mc.	Coil, R.F.	304988
L513, 514	200μh at 790kc.	Coil, R.F.	304989
L515-518	80μh at 2.5 Mc.	Coil, R.F.	304990
L519-522	80μh at 2.5 Mc.	Coil, R.F.	304987
L523,524	80μh at 2.5 Mc.	Coil, R.F.	304990
L525,526		Choke, R.F.	305220
L527-530		Choke, R.F.	305223
L531,532		Choke, R.F.	305214
L533,534		Choke, R.F.	305225
L535		Choke, R.F.	305224

Reference Designation	Value	Description	BRC Part No.
L536,537	100μh at 2.5 Mc.	Choke, R.F.	305146
L538		Choke, R.F.	305219
L539		Choke, R.F.	305221
L540		Choke, R.F.	305222
L541,542		Choke, R.F.	305218
L543		Choke, R.F.	305217
L544,545	100μh at 2.5 Mc.	Choke, R.F.	305146
L546		Coil, R.F.	305204
L547		Choke, R.F.	305223
L548		Choke, R.F.	305224
L549		Coil, R.F.	305205
L550	80μh at 2.5 Mc.	Coil, R.F.	304990
L551		Choke, R.F.	305215
L552		Choke, R.F.	305216
L553		Choke, R.F.	305214
L555		Choke, R.F.	305225
L556	35μh at 2.5 Mc.	Choke, R.F.	305229
L557	50μh at 2.5 Mc.	Choke, R.F.	305230
L558		Coil, R.F.	305203
L559		Choke, R.F.	305230
L561	1.76μh at 7.9 Mc.	Coil, R.F.	305057
L562,563	3.11μh at 7.9 Mc.	Coil, R.F.	305055

Reference Designation	Value	Description	Part No.
L564	1.76μh at 7.9 Mc.	Coil, R.F.	305057
L565	0.483μh at 2.5 Mc.	Coil, R.F.	305056
L566	10.8μh at 2.5 Mc.	Coil, R.F.	305232
L567	9.1μh at 7.9 Mc.	Coil, R.F.	305233
L568	7.6μh at 7.9 Mc.	Coil, R.F.	305234
L569	6.3μh at 7.9 Mc.	Coil, R.F.	305235
L570	4.2μh at 7.9 Mc.	Coil, R.F.	305236
L571	3.7μh at 7.9 Mc.	Coil, R.F.	305237
L572	3.4μh at 7.9 Mc.	Coil, R.F.	305238
L573	3.15μh at 7.9 Mc.	Coil, R.F.	305239
L574		Coil, R.F.	305210
L575		Choke, R.F.	305214
L576		Coil, R.F.	304707
L577	100μh at 2.5 Mc.	Choke, R.F.	305146
M501		Meter, Arbitrary Scale	301951
P501+503		Connector, Plug	94156
P504		Adapter, Connector	305144
P505-509		Connector, Plug	94156
P510		Connector, Plug	304815
P511		Connector, Plug	304817
P512,513		Connector, Plug	305167

Reference Designation	Value	Description	BRC Part No.
P514		Connector, Plug	94156
R501	500kΩ	Res. Var. ±10% 2W	81068-8
R502	1.5kΩ	Res. Fixed Comp. ±5% 1W	80023-19
R503	1kΩ	Res. Var. ±10% 2W	81068-5
R504	1kΩ	Res. Fixed Comp. ±5% 1W	80023-16
R505	1 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-35
R506	5kΩ	Res. Var. ±10% 1/3 W	81068-4
R507	2.5kΩ	Res. Var. ±10% 2W	81069
R508	1 Meg Ω	Res. Fixed Comp. ±5% 1/2W	80022-35
R509,510	100Ω	Res. Fixed Comp. ±5% 1W	80023-23
R511	22kΩ	Res. Fixed Comp. ±5% 1W	80023-2
R512	100Ω	Res. Fixed Comp. ±5% 1W	80023-23
R513	10kΩ	Res. Fixed Comp. ±5% 2W	80024-2
R514,515	100Ω	Res. Fixed Comp. ±5% 1W	80023-23
R516	470kΩ	Res. Fixed Comp. ±5% 1/2W	80022-18
R517	15kΩ	Res. Fixed Comp. ±5% 2W	80024-3
R518	82kΩ	Res. Fixed Comp. ±5% 1/2W	80022-63
R519	10Ω	Res. Fixed Comp. ±5% 1/2W	80022-59
R520	100Ω	Res. Fixed Comp. ±5% 1/2W	80022-2
R521	10Ω	Res. Fixed Comp. ±5% 1/2W	80022-59
R522	10kΩ	Res. Fixed Comp. ±5% 1/2W	80022-9
R523	470Ω	Res. Fixed Comp. ±5% 1/2W	80022-4
R524	5.6kΩ	Res. Fixed Comp. ±5% 1/2W	80022-62
R525	8.2kΩ	Res. Fixed Comp. ±5% 2W	80024-22
R526	180Ω	Res. Fixed Comp. ±5% 1/2W	80022-60
R527	15kΩ	Res. Fixed Comp. ±5% 1/2W	80022-10
R528	10kΩ	Res. Fixed Comp. ±5% 1W	80023-17

Reference Designation	Value	Description	BRC Part No.
R529	1.5kΩ	Res. Fixed Comp. ±5% 1/2W	80022-32
R530	10kΩ	Res. Fixed Comp. ±5% 1/2W	80022-9
R531	15Ω	Res. Fixed Comp. ±5% 1/2W	80022-44
R532	39kΩ	Res. Fixed Comp. ±5% 1/2W	80022-54
R533	180Ω	Res. Fixed Comp. ±5% 1/2W	80022-60
R534	10kΩ	Res. Fixed Comp. ±5% 1/2W	80022-9
R535	4.7kΩ	Res. Fixed Comp. ±5% 1W	80023-21
R536	10kΩ	Res. Fixed Comp. ±5% 2W	80024-2
R537	10kΩ	Res. Var. ±10% 1/3W	81068-10
R538	150Ω	Res. Fixed Comp. ±5% 1/2W	80022-46
R539	4.7kΩ	Res. Fixed Comp. ±5% 1/2W	80022-7
R540	180Ω	Res. Fixed Comp. ±5% 1/2W	80022-60
R541	10kΩ	Res. Fixed Comp. ±5% 1/2W	80022-9
R542	66.9kΩ	Res. Fixed Film ±1% 1W	80582-4
R543,544	16.61Ω	Res. Fixed Film ±1% 1W	80582-3
R545	82kΩ	Res. Fixed Comp. ±5% 1W	80023-25
R546	39kΩ	Res. Fixed Comp. ±5% 1W	80023-24
R547	220kΩ	Res. Fixed Comp. ±5% 1/2W	80022-16
R548	82kΩ	Res. Fixed Comp. ±5% 1/2W	80022-63
R549,550	16.61Ω	Res. Fixed Film ±1% 1W	80582-3
R551	66.9kΩ	Res. Fixed Film ±1% 1W	80582-4
R552	51Ω	Res. Fixed Comp. ±5% 1/2W	80022-1
R553	68kΩ	Res. Fixed Comp. ±5% 1/2W	80022-13
R554	82kΩ	Res. Fixed Comp. ±5% 1W	80023-25
R555	68kΩ	Res. Fixed Comp. ±5% 1/2W	80022-13
R556	10kΩ	Res. Fixed Comp. ±5% 1/2W	80022-9

Reference Designation	Value	Description	BRC Part No.
R557-564	10kΩ	Res, Fixed Comp. ±5% 1W	80023-17
R565	4.7kΩ	Res. Fixed Comp. ±5% 1/2W	80022-7
R566	100kΩ	Res. Fixed Comp. ±5% 1W	80023-18
R567	150kΩ	Res. Fixed Comp. ±5% 1/2W	80022-22
R568	10kΩ	Res. Fixed Comp. ±5% 1/2W	80022-9
R569,570	220kΩ	Res. Fixed Comp. ±5% 1/2W	80022-16
R571	4.7kΩ	Res. Fixed Comp. ±5% 1/2W	80022-7
R572	22kΩ	Res. Fixed Comp. ±5% 1/2W	80022-33
R573	120kΩ	Res. Fixed Comp. ±5% 1/2W	80022-64
R574		Res. Special	304832
R575	49.9Ω	Res. Fixed Film ±1% 1/4W	80583-1
R576-578	10kΩ	Res. Fixed Comp. ±5% 1W	80023-17
S501		Switch, Rotor	304587
S502		Switch, Thermostat	304681
S503		Switch, Thermostat	304680
S504,505		Switch, Rotary	304448
S506,507		Switch, Rotary	304449
T501		Transformer, R.F.	305202
T502		Transformer, R.F.	305201
T503		Transformer, R.F.	305211
T504		Transformer, R.F.	305209
T505		Transformer, R.F.	305206
T506		Transformer, R.F.	305207
T507		Transformer, R.F.	305208
V501		Electron Tube, 5718	91308-20
V502		Electron Tube, 5725	91308-18

Reference Designation	Value	Description	BRC Part No.
V503-505		Electron Tube, 5654/6AK5W	91308-17
V506		Electron Tube, 5725	91308-18
V507		Electron Tube, 5654/6AK5W	91308-17
V508,509		Electron Tube, 6AN4	
V510,511		Electron Tube, 6AU6WA	91308-10
V512		Electron Tube, 6AH6	91308-4
V513,514		Electron Tube, 5654/6AK5W	91308-17
V515		Electron Tube, 12AT7WA	91308-8
V516		Electron Tube, 6E5	91308-1
Y501-526		Quartz Crystal	304832
Z501		Attenuator, Piston	305240

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